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EDMUND BEECHER WILSON[1]

By Professor THOMAS HUNT MORGAN

CALIFORNIA INSTITUTE OF TECHNOLOGY

EDMUND BEECHER WILSON was born on October 19, 1856, at Geneva, Illinois. The first sixteen years of his life were passed there.

When Wilson was not quite sixteen his uncle Davis suggested that he take over the "little country district school" that his brother Charles had taught the year before. The offer was thirty dollars a month and board (with his aunt and uncle). "When the thermometer stood at thirty degrees below zero, as it did at times, this was, I assure you, no joking matter. I wonder how the modern city-bred youth would like such an experience. I had only twenty-five pupils or so, of all ages from six to eighteen, and I had to teach all grades, from the three R's up to history and algebra."

In the following summer he was in Geneva, where his cousin, Sam Clarke, had just returned from Antioch College. "As the summer passed I had gradually made up my mind to try for a college education and a life devoted to biology or at least to science." "I had nothing but my two hundred dollars and with this in hand I packed up my meager outfit in September and started for Antioch College in Southern Ohio." The college was a very simple one but with sound ideals. "We had good teachers. Here, for the first time I received regular instruction in zoology and botany, in Latin, in geometry and trigonometry

[1] Condensed from a memoir presented to the National Academy of Sciences.

and especially in chemistry with regular laboratory work, and I reveled in it all."

In June (1873) he went back to Geneva, where with a tutor he began to study Greek. Instead of returning to Antioch in the fall a new prospect opened. Sam Clarke wrote enthusiastic letters from the Sheffield Scientific School at Yale. "In turning towards Yale I was influenced not merely by Clarke's example but in part by the reputation of the professors of zoology, botany, comparative anatomy and geology, and in part by the almost equally compelling consideration to poor students that Yale offered many advantages in the way of self support. I felt, however, not yet fully prepared . . ." Wilson spent the winter with his family in Chicago in attendance at the university there, preparatory to Yale. Hearing of an opening as recorder in the Lake Survey he easily passed the examination, and was accepted at a salary of a hundred dollars a month. He took part in the primary triangulation of Lakes Ontario and Erie, which lasted until September; then he started east to enter Yale.

He entered the Scientific School at Yale in 1875 and graduated three years later with the degree of Ph.B. He remained there one year more doing graduate work and acting as assistant. During the first year at Yale he took courses in zoology with Verrill, in botany with Eaton and embryology with S. I. Smith. He then decided to regularize his work so that it would lead to the bachelor's degree. His three undergraduate years were, he writes, very busy and very happy years. At the end of the last year at Yale, Wilson was offered a position for the following year, but both Sedgwick, with whom he was on intimate terms, and Wilson himself were getting roseate reports from Sam Clarke, who was then at Johns Hopkins University. Both applied for fellowships there and were duly appointed.

At the end of his first year at Johns Hopkins both he and Sedgwick were reappointed to fellowships and in the third year to assistantships. His three years there opened a new world of ideals; he became aware, he says, of new horizons of research, and wider outlooks in biology. His teachers were H. Newell Martin and W. K. Brooks. It was with the latter that he carried out most of his own work. "It was through informal talks and discussions in the laboratory, at his house, and later at the summer laboratories by the sea that I absorbed new ideas, new problems, points of view, etc." "Through him I first discovered what I really wanted to do." "From him I learned how closely biological problems are bound up with philosophical considerations. He taught me to read Aristotle, Bacon, Hume, Berkeley, Huxley; to think about the phenomena of life instead of merely trying to record and classify them."

Wilson had more and more wished to study in Germany. At the end of the summer of 1882 he sailed to Liverpool. Newell Martin had given him a letter to Huxley, who expressed much interest in the work on Renilla. Later he arranged to have the memoir on Renilla published by the Royal Society.

Wilson settled down at Cambridge. Balfour had been killed in the Alps, but his assistants and students were there, and Wilson recalls meeting Adam Sedgwick, Heape, Caldwell and Bateson. He also met Michael Foster and attended his lectures. He returned to London to give his paper before the Royal Society and then left for Germany. After spending a few weeks in the small village of Thurm to familiarize himself with spoken German he went to Leipzig. Here he worked in Leuckart's laboratory and also attended a few of Ludwig's lectures on physiology. He introduced the section-cutting method that Caldwell had invented in England and it created a sensation. In Leipzig he heard a great deal of the best music.

Naples produced a deep and lasting impression on Wilson. The station came up fully to his expectations. There he came to know Anton Dohrn, with whom he formed a sincere friendship, Hugo Eisig, Edourd Meyer and Arnold Lang—names that are familiar to many American zoologists who have followed in Wilson's footsteps to Naples.

Sedgwick and Wilson had been much interested in the course in biology at Johns Hopkins given by Newell Martin, where in the laboratory the well-known book of Huxley and Martin was used. While at Williams they began planning along somewhat different lines a text-book of general biology. In part to carry out their plan of collaboration Wilson was offered a lectureship with Sedgwick at the Massachusetts Institute of Technology. The book appeared in 1885 and was very successful.

Bryn Mawr College, a new institution for the higher education of women, was to be opened in the fall of 1885 and Wilson was invited to take charge of the department of biology. The college had been founded by Quakers and from the beginning adopted a liberal, even advanced, policy in its educational aims. This policy was largely due to Miss M. Carey Thomas, who as dean and later as president introduced the same standards as those followed by Johns Hopkins. Wilson taught at Bryn Mawr from 1885 to 1891 and had wonderful success, attracting to his classes many of the ablest students in the college.

Henry Fairfield Osborn had accepted a call from Columbia to establish a new department of zoology. He offered Wilson the position of adjunct professor to cooperate with him in organizing the new department. The offer included an arrangement by which Wilson would be given a year of foreign study before

starting on his duties at Columbia. The second year in Europe was spent mainly in Munich and Naples and was even more productive and delightful than the first one, scientifically, because it settled definitely his later line of study, namely, cellular and experimental embryology. Boveri was at that time in Munich, and it was his presence there that had determined Wilson's choice of a place to work. Boveri was "far more than a brilliant scientific discoverer and teacher. He was a many-sided man, gifted in many directions, an excellent musician, a good amateur painter, and we found many points of contact far outside of the realm of science."

At the end of the year he went to Naples with the Norwegian Hjort as traveling companion. At the station he met Driesch and Herbst, both students of experimental embryology, which at that time was a relatively new field and to which Wilson was soon to make valuable contributions. Driesch's work on the experimental production of twins interested Wilson intensely, because of its bearing on his own work on the development of the earthworm and Nereis, then in press. In the spring of 1892 he went to Sicily to study the embryology of Amphioxus. Returning to Naples he sailed for Genoa, where he saw the famous Joseph Guarnerius violin of Paganini. "The thrill that it gave me was only equalled by my ascent of Etna."

In 1904 Wilson married Anne Maynard Kidder, the daughter of Dr. Jerome Henry and Anne Maynard Kidder. Dr. Kidder was a friend of Spencer F. Baird, who established the United States Fish Commission at Woods Hole. The Kidder family, who lived in Washington, D. C., built a summer cottage at Woods Hole and were on the most friendly terms with members of the Marine Biological Station. After the death of Dr. Kidder, Mrs. Kidder continued to go to Woods Hole. Many of us will remember her as charming, cultivated, witty and hospitable and she was regarded by us as much a member of our group as though an official member of it. It was at Woods Hole that Wilson first knew Anne Kidder, whose marriage to him added officially another valuable member of that family to the Woods Hole group. Their daughter, Nancy, Mrs. John Lobb, became a professional cellist of outstanding ability, and, during the latter years of Wilson's life, one of his greatest pleasures was watching her progress in her profession. This, in a sense, rounded off Wilson's passion for music.

Wilson's first extensive work, "The Development of Renilla," was published in 1883 in the Philosophical Transactions of the Royal Society, London. It was a splendid piece of descriptive work, admirably presented. The sixteen plates that illustrate the text are an example of his skill and taste in drawing.

During the six years he taught at Bryn Mawr College (1885–1891) he published a brief account of the movements of Hydra, and an extensive paper on the embryology of the earthworm (1889). After his appointment to Columbia University (1891) his research productivity steadily increased. In 1892 he published "The Cell-Lineage of Nereis."

The problem of the organization of the egg was an old one, but after the experimental work of Roux on frog's eggs and that of Chabry on ascidians' eggs, and the experimental work of Driesch on sea urchins' eggs, the theoretical deductions that they drew from these experiments, which were opposed, aroused wider and wider interest. From that time onwards the older phylogenetic problems lost interest, and embryologists took up the experimental study of embryology with increasing success and enthusiasm. Much of Wilson's later work was concerned with the evidence and its discussion in this new field.

In 1902 a graduate student, W. S. Sutton, pointed out that the two maturation divisions furnish an explanation of Mendel's laws. Wilson writes, "During the past year working in my laboratory he has obtained more definite evidence in favor of this result (the separation of maternal and paternal chromosomes), suggested by Montgomery (1901), which led him to the conclusion that it probably gives the explanation of the Mendelian problem." This conclusion of Sutton's has turned out to be more than "probable," and is to-day the basis for the mechanism of Mendel's two laws.

The most complete papers that Wilson published in 1904 deal with "Experimental Studies on Germinal Localization." The first deals with the egg of Dentalium; the second with Patella and Dentalium. These papers were the outcome of eight months' residence at the Naples Zoological Station in 1903.

Wilson's most outstanding contributions are his eight studies on chromosomes published from 1905 to 1912. These deal almost exclusively with the reduction divisions during spermatogenesis. Here accuracy of observation and care in interpretation of the behavior of the chromosomes are shown in a high degree. The actual counts of the number of chromosomes is in itself not difficult, at least in those forms that have a small number, and Wilson chose mainly such forms, but the changes that take place during the ripening of the sperm cells call not only for extraordinarily careful observations but also for skill in interpretation. In both respects Wilson was unusually gifted. None of his results has been rejected by later workers, while some of the erroneous chromosome counts of other contemporary cytologists held back for several years the solution of the role of the sex chromosomes in the determination of male and female.

In 1905 Miss Nettie Stevens at Bryn Mawr College

published in the Publications of the Carnegie Institution of Washington an account of the role of the sex chromosomes in the beetle Tenebrio. She showed that the male had 19 large and 1 small chromosome (the Y), the latter going to half the spermatozoa. She also showed that at the reduction division it (the smaller one) was the mate of one of the large chromosomes. Consequently half the ripe sperm had 10 large chromosomes and half had 9 large and 1 small chromosome. In the oogonial cells there were 20 large chromosomes which would reduce to 10 in the egg after maturation. She pointed out that an egg fertilized by a sperm with 10 large chromosomes would give a female with 20 such chromosomes, and that an egg with 10 large chromosomes fertilized by a sperm with 9 large and 1 small chromosome would restore the number characteristic of the male.

In the same year (1905) Wilson published a similar conclusion in regard to the role of the sex chromosomes in two other insects in which the female has one more chromosome than the male; thus *Anasa tristis* ♀ has 22, and the male 21; and Protenor ♀ has 14, and the ♂ 13. The Stevens type XX-XY and the Wilson type XX-XO are the same in principle. It has turned out that the former is much commoner than the latter as a sex-determining mechanism occurring widely in groups other than insects.

Five years after his appointment at Columbia University he published his book on "The Cell" (1896) which was at once recognized as the outstanding summary of the work in this field. Wilson drew upon his wide experience covering, as it did, the role of the cell in fertilization and development, in experimental embryology, in spermatogenesis, as well as thorough familiarity of the work of his contemporaries dealing with the cell. A third and greatly extended edition appeared in 1925. During the interval between the first and third editions, work in cytology had advanced in many directions and a voluminous literature had grown up. In a masterly way Wilson summarized this literature, separating the wheat from the chaff. I can not do better than quote here the words of Professor E. G. Conklin spoken at the time of the award to Wilson of the Daniel Giraud Elliot Medal (for 1925) by the National Academy,

"The third edition of 'The Cell in Development and Heredity' has been written out of this unique experience; it represents not only the mature point of view of the world's leading student and teacher of cytology, but it is to a large extent the work of its leading investigator in this field. Few other workers are left who were in at the birth of this science and who can speak of its development with the knowledge that comes from intimate contact with persons and problems, and no one could deal with this subject in a more comprehensive and judicial manner."

Wilson was a member of all the leading learned societies of Europe and America. He was a recipient of honorary degrees from the universities of Columbia, Harvard, Yale, Johns Hopkins, Chicago, Louvain, Cambridge (England), Lwow and Leipzig. He was awarded the gold medal of the Linnean Society, London; the Elliot Medal of the National Academy of Sciences; the John J. Carty Medal and Award. He will be lovingly remembered by his many friends as a reserved, cultured gentleman whose sincerity, judgment and breadth of knowledge were shown by the perfection of his lectures and his scientific papers.

WIND-WORN STONES IN GLACIAL DEPOSITS OF THE MIDDLE WEST

By Dr. LINCOLN R. THIESMEYER

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FOR many years the plains of the middle western States have been a classic area for studying deposits formed by the Pleistocene ice sheets. The preliminary work of mapping and distinguishing between sheets of debris spread during each successive episode of the Glacial Period is largely completed. In studies encompassing such vast areas many details will be overlooked, however, and left for the attention of later workers. This is not to the discredit of early investigators, for new data are commonly found each time a particular locality or rock outcrop is revisited.

One detail little noticed until recent years is the association with glacial deposits in central interior States of stones that were shaped, etched, modified or polished through abrasion by wind-driven sand. Such stones are common in modern deserts and have been found in many consolidated aeolian deposits, or "fossil deserts." Bryan[1] proposed the general name "ventifact" for all wind-scoured stones.

Hobbs[2] noted abundant ventifacts on barren plains bordering the Greenland ice-cap, where strong winds generated above the ice drive sand, silt and dust over stones too large for the winds to carry. Ventifacts

[1] K. Bryan, *Rept. Comm. on Sedimentation for 1929-30, Nat. Res. Coun. Cir. No. 98*, 1931, pp. 29–50.
[2] W. H. Hobbs, *Jour. Geol.*, 39: 381–385, 1931.

probably were formed under essentially similar conditions all over the glaciated tracts of the world. Bryan[3] has emphasized that arctic conditions favorable to formation of wind-cut stones must have prevailed during advance and retreat of Pleistocene glaciers in the Middle West. Many writers have described a profusion of wind-cut stones associated with glacial deposits in northern Europe and the northeastern United States, but there are few references to such stones in the north central States, and there is not enough descriptive information in most of these reports to indicate whether sand-blasting occurred during glacial or post-glacial time.

Bryan[4] suggested that ventifacts in glacial deposits of southeastern Massachusetts were formed at the surface and then churned underground by frost action, largely in early post-glacial time. He thinks this explanation may also apply to occurrences of ventifacts in other glaciated areas, in published accounts of which the probable date of sand-blast action[5] has not been indicated. The writer and others[6] reported ventifacts in place in undisturbed till and gravel deposits of the Cape Cod area well below depths affected by frost heaving. These authors consider, moreover, that most of the ventifacts were formed long before all the ice had disappeared from the region.

Wentworth and Dickey[7] listed several occurrences of ventifacts associated with glacial and post-glacial deposits of the Middle West, but for most of them it is not specified when the wind-sculpturing occurred. Recently Thiesmeyer and Digman[8] reported wind-cut stones embedded in drift of early (?) Pleistocene age. Previous to publication of that account there were, apparently, only two reports of ventifacts in the central United States known to have been formed *during* the Ice Age.[9]

Three new localities for wind-cut stones in Wisconsin and Michigan have been found during the past year. These are described below to bring the record up to date and to encourage other observers to supplement it. The writer believes systematic search will prove wind-scoured stones as common in glaciated country of the Middle West (and in the Driftless Area) as they are in New England. He suspects that most of them originated while the ice was close at hand, and that their emplacement *within* the deposits will prove related to factors other than frost action in the arctic climate peripheral to the glaciers.

Last spring the writer discovered well-formed ventifacts in a shallow roadcut about three miles east of Crystal Falls, Michigan, on State Highway M 69. The materials underlying this district are glacio-fluvial silts, sands and gravels. Inspection of the sand yielded half a dozen undoubted ventifacts from ¾ to 2 inches in diameter. Quartz, quartzite, granite and several types of porphyritic felsite were represented among the pebbles. It was not possible to determine whether these wind-cut stones had been formed at the surface in post-glacial time, because no clear signs of stratification could be seen in such a shallow roadcut. However, this additional example of ventifacts associated with materials of glacial origin stimulated search for localities where age relationships might be established. In discussion about the stones near Crystal Falls, Professor J Harlen Bretz, of the University of Chicago, disclosed that he had seen many ventifacts in the Baraboo area in Wisconsin. This helpful comment led to the finding of such stones at the third locality, described below.

Later several shallow roadcuts on U. S. Highway 141 four miles southeast of Crystal Falls were examined. Here the highway crosses a broad plain recognized easily as an outwash apron. The material exposed is well washed and sorted, medium to fine sand with occasional streaks of pebbles. Foreset bedding and channeling are evident at several places. A basketful of wind-shaped stones was collected here with little effort. They range in size from ½ inch to approximately 4 inches in diameter. The rock types include quartzite, coarse and fine varieties of granite, diabase, greenstone, red granite gneiss, conglomeratic quartzite and siltstone. Almost every type of wind-sculpturing effect previously observed on ventifacts is represented. Most of the stones were loose upon the slumped surface, but a few were gathered from undisturbed pebble layers several feet beneath the plain surface. This indicates both that they were deposited by glacial meltwaters after shaping in the sand-blast, and that there has been only slight overturning by frost action or plant roots at this locality since the ice disappeared. Some of the ventifacts show modification of their wind-carved features by abrasion during the later water transport.

The third locality is a roadcut 10 to 20 feet deep in till of the Wisconsin terminal moraine on U. S. Highway 12 approximately three fourths of a mile north of its intersection with State Highway 136. Here the moraine rises across a quartzite ridge on the northern boundary of the Baraboo basin. This locality, a scheduled stop on the itinerary of annual field trips to the Baraboo district conducted by several colleges and universities, has been visited by hundreds

[3] K. Bryan, *Am. Jour. Sci.*, 16: 162–164, 1928. (Review and discussion of an article by Paul Kessler.)
[4] K. Bryan, *Bull. Geol. Soc. Amer.*, 44: 176, 1932.
[5] K. Bryan, personal communication.
[6] L. R. Thiesmeyer, K. F. Mather and R. P. Goldthwait, *Bull. Geol. Soc. Amer.*, 50: 1939, 1939; F. E. Matthes, *Jour. Wash. Acad. Sci.*, 24: 195–196, 1934.
[7] C. K. Wentworth and R. T. Dickey, *Jour. Geol.*, 43: 97–104, 1935.
[8] L. R. Thiesmeyer and R. E. Digman, *Jour. Geol.*, 50: 174–188, 1942.
[9] Thiesmeyer and Digman, *op. cit.*, p. 175.

of people trained in geology, including the writer. Yet there is no published record of wind-worn stones here, probably because the visitors' attention was concentrated on more significant details of the deposit.

Close examination of this exposure in April, 1941, by the writer and a class of some thirty Lawrence College students revealed that many of the subangular stones are truly ventifacts. Scores of them were collected in a few minutes, mostly from the slumped surface; but random digging into undisturbed till below a shallow surface zone of weathering produced others. These ventifacts were evidently carried by the glacier in moving to its terminal position and then deposited in the morainic debris that now marks its former margin. Sand-blasting must have occurred earlier while the stones lay in a belt peripheral to advancing ice.

A white quartzite boulder 3½ feet in long diameter, extricated from till just beneath the moraine surface, was taken to the college museum. More than half its surface area bears shallow, subparallel cusps, grooves and flutings characteristic of many ventifacts, and these have a luster like Cellophane. Such surfaces are merely modifications of curving, conchoidal fracture faces commonly found on quartzite. Their arrangement shows clearly that the rock rolled into several positions during sand-blasting. The total amount of material removed by abrasion was apparently not sufficient, however, to give the whole stone a distinctive pyramidal or polygonal shape common among smaller ventifacts.

Most of the wind-carved rocks collected here are fragments of locally abundant Baraboo quartzite; but a few fashioned in coarse granite and felsite porphyry were observed. Consideration of rock types shown on the geologic map of Wisconsin shows that these stones were not transported far from their original positions of outcrop. Fragments of Potsdam sandstone widely distributed north of this did not withstand transportation and weathering sufficiently to retain the evidences of wind-sculpturing they may also originally have displayed.

In a region where surface rocks bordering and beneath the ice were friable quartz sandstones that yielded abundant sand to glacially generated winds conditions must have been especially favorable to formation of ventifacts. Consequently, it seems probable that glacial deposits of the Baraboo region contain a profusion of these curious stones.

The writer will welcome information concerning wind-cut stones at other places in the central States. He urges that the discoverer determine if possible: whether the stones occur within the deposit; at what depth beneath the surface; to what depth the material is stained by weathering; and whether the deposit is unlayered till or stratified sand and gravel.

Since observers trained in any branch of science may encounter these wind-worn stones, it appears worth while to list below other distinguishing characteristics of ventifacts.

(1) The wind-scoured surface is smooth, lustrous and has a rather greasy feel. The polish may vary from a dull mat finish to a gloss like Cellophane.

(2) The surface may be pitted, fluted, cusped or highly irregular through etching out of its less resistant portions. A wind-etched stone is distinguished from one produced by differential solution in weathering by smoothness and high luster of wind-eroded portions. Surfaces developed by solution processes are commonly dull, pitted and "chalky-feeling."

(3) Some ventifacts have distinctive polygonal shapes formed by carving of several rather flat facets across what were originally rounded pebble and cobble surfaces. These stones may be pyramidal, polygonal or shaped somewhat like a brazil nut. The shape attained depends on many factors, including: shape of original fragment, length of exposure to abrasion in one position, constancy of wind direction, resistance and texture of the stone, size of abrasive, mineral composition of stone and abrasive, number of times the stone rolled into new positions during sand-blasting, and amount of surface exposed to abrasion. Consequently, stones of almost any shape may bear evidence of wind-sculpture. Smoothness, greasy feel and high luster are the chief diagnostic things to observe on a surface that one suspects is a wind-cut facet.

OBITUARY

WILLIAM SCHAUS
1858–1942

THE death of Dr. Schaus on June 20 removed one of the last of the elder lepidopterists who have contributed most to our knowledge of the neotropical fauna. For over forty years he labored consistently and with unswerving devotion to one end, the building up of the most complete collection of tropical American Lepidoptera in the world, not for himself nor his personal profit but for the nation. He contributed generously to other institutions, notably the British Museum of Natural History, the Carnegie Museum at Pittsburgh and the American Museum of Natural History; but the bulk of his collection and his valuable library were given to the U. S. National Museum, and there he worked for the last twenty years of his active life. He described over five thousand new species, mostly from tropical America. With few exceptions

the types of these are deposited in the National Collection.

Dr. Schaus was born in New York City on the 11th of January, 1858. His father was the well-known art collector and dealer, William Schaus, Sr., proprietor of the Schaus Galleries, born in Germany and naturalized as an American citizen in 1854. His mother (born Margaret Connover) was from an old American family. Young Schaus was born to affluence and it was intended that he should carry on the business of his father. He received his early education at Exeter Academy and was sent abroad to finish his education in France and Germany. His principal training was in art, music and languages; but as a young man he came under the influence of Henry Edwards and found his real vocation. He decided, despite parental opposition, and at the sacrifice of a promising career as successor in his father's business, to devote his life to the study of Lepidoptera. He made his first collecting trip into Mexico in 1881. Thereafter he made frequent and extended trips with his companion and friend, Jack Barnes, to Mexico, Costa Rica, Guatemala, Panama, Cuba, Jamaica, Dominica, St. Kitts, the Guianas, Colombia and Brazil and collected over 200,000 lepidoptera. From 1901 to 1905 he lived at Twickenham, England. He visited England and the continent again in 1910 and in 1925 he again visited the continent and brought back the Dognin collection of tropical American Lepidoptera, purchased for the National Collection by funds which he had raised and to which he had contributed substantially. From 1919 until his retirement in July, 1938, he was on the staff of the Bureau of Entomology of the U. S. Department of Agriculture, first as specialist in Lepidoptera and later as entomologist. In 1921 he was made honorary assistant curator of insects of the U. S. National Museum. He was an honorary fellow of the Royal Entomological Society of London; fellow of the Zoological Society, London; honorary correspondent of the Société Entomologique de France; honorary member of the Entomological Society of Brazil; fellow of the American Entomological Society; fellow for life of the Metropolitan Museum of Art; member of the American Association for the Advancement of Science, of the Biological Society of Washington, and of the Entomological Society of Washington; corresponding member of the Philadelphia Entomological Society, and correspondent of the Academy of Natural Sciences, Philadelphia. In 1921 he received the honorary degree of master of arts from the University of Wisconsin and in 1925 that of honorary doctor of science from the University of Pittsburgh.

Few lepidopterists, even of his generation, have had such a wide and intimate knowledge of the world fauna as he. While his main interest centered in the American tropics, he worked with and described many Old World Lepidoptera. He was an accomplished linguist, a lover of art and music, a charming host and the most generous of friends. He was granted blessings that come to few of us, a long life in chosen labor, the satisfaction of completing that labor and a peaceful end.

CARL HEINRICH
EDWARD A. CHAPIN

U. S. NATIONAL MUSEUM

RECENT DEATHS

JOSEPH W. GAVETT, JR., professor of mechanical engineering and chairman of the department at the University of Rochester, died on August 28. He was fifty-three years old.

RAYMOND H. DANFORTH, professor of mechanical and hydraulic engineering and head of the department at the Case School of Applied Science, died on August 31. He was sixty-four years old.

DR. CHARLES E. CASPARI, dean and professor of chemistry emeritus of the St. Louis College of Pharmacy, died on June 11 at the age of sixty-seven years.

ELEANOR CATHERINE DOAK, professor emeritus of mathematics and a former chairman of the department at Mount Holyoke College, died on August 27 at the age of seventy-two years.

ARTHUR H. THOMAS, president of the Arthur H. Thomas Company, died on August 31. A correspondent writes: In 1892 he entered the employ of the old Philadelphia firm of James W. Queen & Co., dealers and makers of optical and scientific instruments. On December 8, 1900, Mr. Thomas organized the Arthur H. Thomas Company, dealers in laboratory apparatus and reagents, of which he was president. This company grew rapidly and has become one of the leaders in this field. He was deeply interested in education and at the time of his death was a trustee and director of Bryn Mawr College and a member of the Board of Managers of Haverford College. He was also a member of the Board of the Provident Mutual Life Insurance Company.

SCIENTIFIC EVENTS

THE ZOOLOGICAL SOCIETY OF LONDON AND THE NATURAL HISTORY MUSEUM AT SOUTH KENSINGTON

THE report of the Zoological Society of London for 1941 was presented at the annual meeting of the society on August 19. In an advance notice printed in *The Times*, London, it is stated that both Regent's Park and Whipsnade suffered several times

from air raids during 1940 and 1941. There were 11 incidents in all, eight in London and three at Whipsnade. Fifty-five high explosive bombs, 200 incendiaries and two oil bombs fell in the society's grounds. Although considerable material damage was done, there were no serious casualties among the staff or visitors, and very few among the animals. The number of visitors to Regent's Park in 1941 was 512,966, a decrease of approximately 119,000 compared with 1940, and the lowest figure since 1864. In spite of decreased traveling facilities the number of visitors to Whipsnade in 1941 was 246,139, an increase of approximately 43,000 compared with the previous year. The policy of the council is to keep Regent's Park and Whipsnade open and to preserve the bulk of the collections. Apart from the national service rendered by keeping places of healthy recreation available to fellows, war-workers, members of the armed forces and the general public, the council considers that this is in the best interests of the society in preparing for the speediest possible resumption of full activity after the war.

The Times also reports that the Natural History Museum at South Kensington reopened some of its galleries on August 1. It is stated that the parts of the museum which are reopening are all on the ground floor. They are the Central Hall, North Hall, Bird Gallery, Insect Gallery, Reptile Gallery and Whale Room. Visitors will not find all these filled with the exhibits they knew there in peace-time, since only things which could be replaced have been left on view. Nevertheless, many of the most popular exhibits, such as the great casts and skeletons of whales, the fascinating nesting groups of British birds and the series of domestic animals (dogs, cattle, horses, poultry, etc.) in the North Hall are still to be seen. British butterflies and moths are among the specimens in the Insect Gallery; and the Reptile Gallery now contains a miscellaneous collection, including a series of the British mammals. Another miscellaneous arrangement is that in the Central Hall, where many of the familiar peace-time features, for instance, the elephants and some of the groups showing protective coloring, remain. In addition, there are special exhibits illustrating the animals of the Libyan desert and some of the essential mineral ores. A large map of the world showing the sources of the most important minerals is another topical feature.

THE IMPORTANCE OF RESEARCH IN THE WAR EMERGENCY

THE following resolution concerning the importance of research in the war emergency was adopted by the Council on Research of the Pennsylvania State College on August 24:

In times of great stress such as confront the nation to-day there is a tendency to subject the activities of public institutions to rigid scrutiny and careful evaluation. Colleges and universities are not excepted in this desirable and necessary practice. In fact a periodic self-scrutiny and self-evaluation is helpful. Colleges and universities more than any other public institution must be living things. They, therefore, must not only be nourished, but from time to time, they must be pruned if they are to flourish and give forth bountiful and good fruit.

When the three functions of a great university are considered, there is a tendency in some quarters to look upon research as a luxury, to place it in the category of Sunday driving, pleasant, satisfying but unnecessary. This is unfortunate because the research ability and effort of its people constitute the greatest resource of the nation. The colleges and universities are the chief centers of training for research. As with the nation so with the college there is need for research activity at all times and under all conditions.

Great colleges and universities are measured not in terms of campus and buildings but in terms of human achievement. In the last analysis the accomplishments of the men and women that make up its faculty and students determine the greatness of such institutions. And it is in this respect that the spirit and activity of research are most important, for research is an intellectual vitamin which makes vigorous leaders of faculties. Education, when livened by research, is evocative, and curiosity and zest for discovery pervade the atmosphere of the classroom. Research cultivates a spirit of adventure and a desire in the student to explore the borders of knowledge. It is hard to see how teaching can be great without some contact with exploration of intellectual frontiers. Research and teaching by research constitute the nourishment by which universities are kept at the highest level in the service of the nation.

However, two other considerations are important in the evaluation of the research function of the Pennsylvania State College. One of these relates to the war effort. The war is as much a war of wits as of might, and mobilization of our inventive genius is of utmost importance. Colonel G. F. Jenks, of the Ordnance Department, U. S. Army, as chairman of Committee E-9 on Research, reported on research activities of the American Society for Testing Materials on June 24, 1942. His report reads in part as follows:

"Of course, our national research activities must be directed primarily to the development of implements of war, to improving our situation as to raw materials and transportation and to the development of superior processing methods. . . .

"The quantity of research personnel available is not readily expanded because of the training and aptitude required for successful work. The output of the country's research personnel can be increased through the utilization of agencies equipped to outline without delay logical research programs without unnecessary duplication of work and with a clear understanding of the problem. . . .

"There can be no question as to whether research is fundamental. The fundamental approach may consume

less time than less well-organized hit-and-miss methods. A fundamental knowledge assists both in the interpretation and application of research. It is especially needed in time of war when new untrodden fields must be explored. There can be no limitation fixed because of the time factor. It is beyond human power to predict when this war will end. It is certain, however, that cooperative research efforts directed to the ends of national policy will shorten the period of this world struggle.''

This recognition of the importance of research by the military authorities is further demonstrated by two recent official actions.

1. The Selective Service System through Occupational Bulletin 10, effective June 18, 1942, specifically provides for deferment of graduate students in a variety of critical occupations covering almost all schools of the college.

2. The U. S. Army in planning for the Enlisted Reserve specifically provides for a group of graduate students.

It is of course recognized that graduate students can not be trained effectively without experience in research.

The other factor is summed up in the statement that colleges and universities are the logical and perhaps the only remaining centers for freedom of search for truth. The torch of knowledge is in danger of extinction. To guard against such a catastrophe these institutions must foster the continued search for truth, must zealously protect the research function and must in every way possible support research effort.

The Council on Research submits that to-day as never before in the history of the Pennsylvania State College there is an urgent need for a vigorous research effort on the part of the faculty and that research must have the fullest possible support of the administrative officers and the Board of Trustees.

REPORT OF THE LIBRARIAN OF NEW YORK UNIVERSITY

THE Libraries of New York University are continuing to acquire a few scientific periodicals from the Axis-dominated countries of Europe, according to the annual report of Robert B. Downs, director of the libraries, which has now been made public.

The books are acquired under a recent decision of the U. S. Government and the British Ministry of Economic Warfare to permit American libraries to pay up to the sum of $250,000 for the purchase of journals which may be useful to the war effort. Since this amount is no more than a fraction of the sum ordinarily spent for European publications by institutions in this country, each research library has been allotted only those titles which it considers most essential to its needs.

The New York University libraries receive a highly selected list of periodicals in the fields of biology, chemistry, physics, geology and medicine from Germany, France, Denmark, the Netherlands and Italy. The subscriptions are purchased through dealers in neutral countries and are inspected by the British at Bermuda and by the United States customs officials at the port of entry before delivery to the university.

According to the report, so far there has been little evidence of political tampering in the areas of the pure sciences. This is naturally not true in the fields of the social sciences. Although in the physical sciences much material is obviously omitted if it may be of military importance, it is felt that enough articles of scientific value come through to compensate for the expense and trouble of obtaining the journals. Gifts and accessions are reported as follows:

The university libraries received gifts of more than 10,000 volumes valued at more than $75,000 during the past year. Notable gifts included a library of books on Judaica and Hebraica for the study of Jewish history, philosophy and religion from Dr. Mitchell Kaplan, and a collection of rare volumes in the same field from William Rosenthal.

The Fine Arts Library received several hundred books on art, including the files of a rare periodical devoted to the fine arts of Japan, from Robert Lehman, a member of the New York University Council; Dr. Moses Leo Gitelson established as a memorial to his brother, Raphael Gitelson, a special fund for the purchase of works in the field of American and British economic history; Henry B. Fernald presented several notable early editions in English literature, and Dr. Charles W. Gerstenberg presented an interesting collection of English and American literary annuals, or ''gift-books.''

Through a gift by Miss Margaret Barclay Wilson, the library purchased a collection of manuscript journals and letters of Henry Barnard, pioneer educational leader. The Society for the Libraries presented extensive microfilm collections of materials for the study of American culture, including reproductions of all known extant magazines published in the United States before 1800 and a collection of complete texts of 250 representative books about America beginning with 1943.

Mr. Downs states that in a recent survey by the American Library Association the collections of New York University had been rated "distinguished" in sixteen special fields: Classical papyri, German language and literature, French language and literature, French history (Huguenot), German history, French philosophy, Hegel, Jewish history and literature, sociology, education, international law and relations, economics, labor and industrial relations, meteorology, psychology and aeronautics. The survey covered a list of 75 subjects and the nation's libraries were rated in those fields by 500 scholars and other authorities. Mr. Downs also reported that the U. S. Office of Education and the New York State Education Department had named New York University as a War Information Center.

MATHEMATICIANS AND THE WAR

THE following cablegram has been sent to SCIENCE from Dr. A. Kolmogorov, a member of the Academy of Sciences of the USSR at Moscow:

All trials of the patriotic war which our country is waging against Hitlerism haven't stopped the intensive work of Soviet mathematicians. In Moscow and in all other towns mathematical research institutes are working full speed, lectures are being delivered at universities, scientific societies are meeting, mathematical journals are being printed.

Many young Soviet mathematicians are bravely fighting German vandals at the front. Nevertheless they keep in touch with science. In the last issues of *Doklady* of the Academy of Sciences, USSR, several notes have been printed by W. Smulian, "Acting Red Army," which he has written at the front. The last works by D. Raikov were written in the hospital where he was recovering after having been wounded at the battle of Moscow in the autumn of 1941.

The number of mathematicians that are working at mathematical war problems necessary for defense of our country increases daily. Stalin prizes were assigned in 1941 to mathematicians Christianovitch and Kelych for works on aerodynamics connected with problems of plane structure. Many mathematicians who had formerly devoted themselves to the purely abstract domains of our science—number theory, mathematical logi, topology, functional analysis—are now steadily working on problems of aerodynamics. Many of our well-known mathematicians are working at military plants and artillery polygons. We are full of admiration for the splendid and productive work of American mathematicians in all branches of our science. We are enchanted with the careful, irreproachable issues of English mathematical journals throughout all the terrible air raids, but we are especially satisfied when we read in the *Bulletin* of the American Mathematical Society that American mathematicians are beginning to concentrate their attention on war problems. All the future of our splendid science and the fate of humanity depend now on success in the struggle against war, and, in the first place, against German aggression. The sooner the aggressors are crushed, the sooner shall we mathematicians be able to meet at our next international congress and freely renew our peaceful work.

IN HONOR OF HENRY GRANGER KNIGHT

THE American Institute of Chemists has passed the following resolution in honor of Henry Granger Knight, past president of the institute.

WHEREAS, We, the National Council of The American Institute of Chemists, Inc., have learned with deepest sorrow of the death of our associate and friend, Dr. Henry Granger Knight, and

WHEREAS, Dr. Knight as a teacher has imbued many young men with an enthusiasm for chemistry and an appreciation of its importance to humanity, and

WHEREAS, as Chief of the Bureau of Chemistry and Soils, now the Bureau of Agricultural Chemistry and Engineering of the United States Department of Agriculture, he has been of inestimable value to the agricultural industry of the United States and through it to every American citizen, and

WHEREAS, as President of The American Institute of Chemists, he gave evidence of his interest in the individual chemist as a medium for the advancement of successful civilization, and

WHEREAS, in recognition of his noteworthy and outstanding service to the science of chemistry and the profession of the chemist in America, The American Institute of Chemists, Inc., did bestow upon him its annual medal, and

WHEREAS, his high sense of honor, his upright character and his clear judgment will ever be an inspiration to us, and

WHEREAS, his lovable nature, his cheerfulness, and his kind and thoughtful qualities will ever be remembrances of his friendliness,

Therefore, be it Resolved, that the Council of The American Institute of Chemists, Inc., hereby records its lasting appreciation and deep sense of loss of one who has been a true friend of chemists; and that our sympathy be extended to his family; and that a copy of these resolutions be spread upon the minutes of the National Council of The American Institute of Chemists, Inc.

SCIENTIFIC NOTES AND NEWS

DURING his visit to Mexico, Peru, Chile, Argentina and Uruguay from February to August, 1942, Dr. George D. Birkhoff, Perkins professor of mathematics at Harvard University, attended the inaugurations of the Observatories at Tonantzintla, Mexico, and Busque Allegre in Argentina, as delegate, and gave lectures on mathematical, physical and philosophical topics in a number of universities in these countries. He was incorporated formally as honorary member of the faculties of the National University of San Marcos at Lima and of the University of Chile, and received the degree of doctor, *honoris causa,* at the University of Buenos Aires. He was also made a corresponding member of the National Academy of the Mathematical, Physical and Exact Sciences at Buenos Aires, and was incorporated as honorary member of the Peruvian Philosophical Society, of the Scientific Union of Argentina and of the Mathematical Society of Argentina.

RALPH W. FREY, research chemist of the U. S. Department of Agriculture, has been given the W. K. Alsop Award by the American Leather Chemists As-

sociation for "outstanding research work advancing the art of the science of leather manufacture."

DR. B. H. WILLIER, professor of zoology and chairman of the Division of Biological Sciences at the University of Rochester, was elected president of the Society for the Study of Development and Growth at the recent meeting of the Society at North Truro, Mass.

PORTRAITS of Dr. William S. Carter, formerly professor of physiology and dean of the Medical School of the University of Texas, and of the late Dr. Harry O. Knight, formerly professor of anatomy, have been presented by the University of Texas Medical Alumni Association to the University of Texas Medical Branch at Galveston.

PROFESSOR HENRY EYRING, of Princeton University, will join the staff of the department of chemistry of the Polytechnic Institute of Brooklyn during the coming academic year as visiting professor of physical chemistry.

THE retirement is announced of Dr. Hugh A. McGuigan, since 1917 professor of pharmacology and therapeutics at the University of Illinois College of Medicine.

DR. DONALD SLAUGHTER, formerly associate professor of pharmacology of the College of Medicine of Baylor University, has been appointed professor of pharmacology and physiology and chairman of the department of the College of Medicine of the University of Vermont.

AT Iowa State College, Professor Joseph K. Walkup, of the University of Pittsburgh, has been appointed head of the department of general engineering, and Professor E. L. Barger, of the University of Arkansas, has been named professor of agricultural engineering. Professor Fred Beard, of the department of animal husbandry, has resigned to take a position in charge of the meat-grading service of the Agricultural Market Administration. Buford McClurg has been made research assistant professor. He will succeed Professor Beard as meat specialist at the college.

DR. ALBERT E. DIMOND, plant pathologist at the Connecticut Agricultural Station, has become assistant professor of botany at the University of Nebraska. Dr. Alfred John Wakeman, who for thirty years has been engaged in chemical research at the station, retired this summer.

DR. M. NOBLE BATES, instructor in histology and embryology at Cornell University, has been appointed associate in histology and embryology at the Jefferson Medical College, Philadelphia.

PROFESSOR MADISON BENTLEY has returned to Cornell University (Morrill Hall, Ithaca, N. Y.) as lecturer in psychology. Besides instruction and research, he will edit and publish *The American Journal of Psychology*, relieving Captain K. M. Dallenbach, who has entered active service in the Plans and Training Branch of the Adjutant General's office.

DR. LOUIS ROUND WILSON has retired after serving for ten years as dean of the Graduate Library School of the University of Chicago. Dr. Wilson, who is sixty-five years old, plans to return to the University of North Carolina, with which he was associated for thirty-one years before he went to Chicago. The Graduate Library School, established by a grant of the Carnegie Corporation and the only Graduate School in the library field, is largely due to the work of Dr. Wilson.

DR. HOMER L. DODGE, director of the new research institute and of the school of engineering physics and dean of the Graduate College of the University of Oklahoma, has leave of absence to permit him to assume on September 15 the directorship of the office of scientific personnel of the National Research Council. He succeeds Dr. J. C. Morris, who will return to his post as professor of physics at Tulane University to supervise a special electronics training program. The office of scientific personnel will continue to assist the army, navy and other war agencies in obtaining competent scientific staffs. It will continue to cooperate with the Selective Service Headquarters, the Office of Education and other agencies in the conservation, training and effective use of technical manpower in the war effort.

PROFESSOR WALTER MUMFORD, chairman of the department of forestry of the College of Agriculture of the University of California and forest economist of the Giannini Foundation, has been appointed first honorary adviser of the National Bureau of Forestry Research of the Republic of China.

WILLIAM H. BAYLIFF, formerly assistant professor of biology and later tutor at St. John's College, Annapolis, Md., has been appointed executive secretary to the Maryland Board of Natural Resources.

DR. T. C. RUCH, of Yale University, and Mrs. Judith Wallen Hunt, of the Bio-Medical Libraries, University of Chicago, have been added to the section editor group of *Biological Abstracts* as editors of the amalgamated Section of Biography, History and Bibliography.

DR. HAROLD L. HANSEN, of Northwestern University, consultant to the Federal Food and Drug Administration, the Federal Trade Commission, the Council on Pharmacy and Chemistry, and secretary of the Council on Dental Therapeutics and director of

the Bureau of Chemistry of the American Dental Association, has been appointed administrative assistant to the president of Winthrop Chemical Company, Inc.

DR. C. M. HARING, professor of veterinary science in the University of California College of Agriculture, has been appointed consultant to the War Manpower Commission.

COLIN CAMPBELL SANBORN, curator of mammals at Field Museum of Natural History, has been commissioned a lieutenant (senior grade) in the U. S. Navy, and Frank Boryca, assistant preparator in the department of botany, has enlisted in the U. S. Marines.

DR. ROBERT G. BERNREUTER, professor of psychology at the Pennsylvania State College, has been granted a leave of absence to accept a major's commission in the U. S. Army Specialists' Corps. He will act as field supervisor of thirty-five national army centers for specialist training of personnel men.

THE Committee of the British Privy Council for the Organization and Development of Agricultural Research has appointed Professor James Gray and Professor F. L. Engledow members of the Agricultural Research Council in succession to Sir Merrik Burrell and Professor D. M. S. Watson, whose terms of office as members of the council have expired.

G. E. FRIEND, medical officer to Christ's Hospital, Horsham, England, has become the honorary general secretary of the British Food Education Society.

THE annual symposium of the Division of Physical and Inorganic Chemistry of the American Chemical Society will be omitted this Christmas because of world conditions.

THE *News Letter* of the American Association of Scientific Workers states that a provisional program has been arranged by the symposium committee (Drs. Shapley, Elliott and Sandow). Four sessions are planned. The first is to take place on Tuesday afternoon, December 29. The subject is "Scientific Research in the War Effort." A meeting on "Scientific Cooperation Between the United Nations" is planned for the evening, with speakers from the various United Nations, perhaps with a wide radio hook-up. The first session of Wednesday, December 30, will deal with "Science in the War of Production" and the final session, in the afternoon, will be a joint session with the National Association of Science Writers on "Morale and Propaganda."

IN view of the scarcity of qualified persons to fill such positions, the Civil Service Commission has issued in revised form its continuously open examinations for technical assistants and junior physicists. For junior physicist ($2,000) the requirements are: completion of a 4-year college course including 18 semester hours in physics. Applications will be accepted from senior students who expect to complete the required courses within six months after filing applications. The technical assistant ($1,440–$1,800) examination contains three optional branches: engineering, metallurgy and physics. For the $1,800 grade, three years of college study is required; for the $1,600 grade, two years; and for the $1,440 grade, one year. Provision is made for the acceptance of technical assistant applications from those who have not completed the required three, two or one year of college study but who expect to complete the required courses within four months after filing applications. Appropriate war-training courses may be substituted for college hours required in any optional branch. There are no age limits for these examinations. No written tests are required. Applications will be accepted until the needs of the service have been met. Applications are not desired from persons engaged in war work unless a change of position would result in the utilization of higher skills possessed by the worker. Announcements and application forms may be obtained at any first- or second-class post office or from the Civil Service Commission, Washington, D. C.

THE *Journal* of the American Medical Association reports that Lankenau Hospital Cancer Research Institute will receive nearly $2,000,000 from the estate of Mrs. Anna C. Burr, who died on March 6. The bequest, which will be used for the study of cancer, will serve as a memorial to Mrs. Burr's husband, Edward H. Burr, who died in 1922.

"ALDERSEA," the Bar Harbor, Maine, summer residence of Miss Mary Robert Coles, who died on October 22, 1941, has been given by her heirs to the Roscoe B. Jackson Memorial Laboratory, the cancer research center at Bar Harbor. The buildings will provide office space for the staff and distinguished visiting investigators, part of the library, space for important experimental work and for scientific meetings.

THE sum of $3,908,310 was collected for the control of infantile paralysis during the national celebration of the President's birthday last January. The expenses of the committee were $207,889 or five per cent. of the amount raised. The *Journal* of the American Medical Association states that New York led the states with contributions of $663,646, California was second with $337,318, Pennsylvania third with $329,684, Illinois fourth with $202,352 and Ohio fifth with $202,236. Theaters raised $1,338,059. Half the proceeds goes to the National Foundation for Infantile Paralysis, whose share is used to sponsor clinical and laboratory research on the disease, provide epidemic aid, and conduct an educational program for both the general public and the medical profession.

The other fifty per cent. remains with the state and county chapters of the foundation, where it is used to provide direct medical assistance to infantile paralysis patients, regardless of age.

BY executive order of President Roosevelt, ten fish and wildlife preserves have been established in New York counties. The Department of the Interior will have jurisdiction over these areas and they will "be reserved as refuge and breeding grounds for native birds and other wildlife and for research relating to wildlife and associated forest resources." The land required for the sanctuaries will remain available to the State of New York for use and management by its conservation department, under the custody of the Fish and Wildlife Service of the Department of the Interior. The preserves in New York Counties include Schuyler and Tompkins, Chautauqua, Allegany, Allegany and Livingston, Ontario and Yates, Oswego, Jefferson and Madison, Delaware and Albany.

WILLIAM L. BATT, deputy chairman of the War Production Board and president of SKF Industries, Inc., of Philadelphia, made the address of welcome at the presentation of the Army-Navy Production Award (the Army-Navy "E") to the Leeds and Northrup Company on September 5. Admiral Henry A. Wiley, U. S. Navy retired, was the Navy's official spokesman and presented the "E" pennant. It was received by C. S. Redding, president of the company, and J. L. Johnson, president of the Employee's Association. Lieutenant Colonel Thomas H. Stilwell, Commanding Officer of the Eastern Pennsylvania District, was the Army's official representative at the ceremonies.

DISCUSSION

ANOMALIES OF COLOR VISION

THE article by Miss Murray on "Color Blindness and Borderline Cases" (SCIENCE, August 7, 1942), is an excellent exposé of the present confusion in regard to what is popularly called "color-blindness"; but in our opinion the revelation is not sufficiently comprehensive.

For twenty years we have been finding persons who fail on the chart tests (pseudoisochromatic tests), of Stilling, Ishihara, *et al.*; but who in all practical situations distinguish colors as well as do the persons called "normal" in color vision; and who have no difficulty with worsted tests and other practical tests. We have found others who pass the chart tests without difficulty, but who show serious defects of color vision in practical life and in real tests.

The reason for this apparent discrepancy is made apparent by the chart tests themselves. These tests usually include one or more charts which can be read by "color-blind" persons, but which can not be read by many who are considered as "normal." This is a paradoxical situation which should impress even a layman. The reading of the charts is assumed to depend on ability to distinguish the colors of which the numbers are made up from the colors of the background (the surrounding spots). Here, however, are charts which the person who is supposedly "normal" can not read, whereas a person who is presumably unable to distinguish the color reads them! The conclusion that the charts do not test color perception is inescapable.

Reading of the numbers in the charts requires that there shall be a difference in appearance between the numbers and the background. Obviously, the difference is not in hue. Actually, a difference in brightness is required; and if the numbers do not differ appreciably from the background in brightness, they can not be discerned. Even among persons classed as "normal," the relative brightness of colors of low saturation (low intensity of the chromatic factor) varies from individual to individual. In other words, some have a slightly higher threshold for certain colors than do others. Spots of small area (such as the spots composing the numbers in the charts), which appear to one person brighter or darker than the other spots composing the background may, to another person, be so little different in brightness that the numbers can not be read. On the other hand, spots which to the average person appear brighter than the background may appear to a really "color-blind" person darker than the background spots; and conversely, spots which to the average person appear darker than the background may appear to certain individuals darker than the background. In either case, the individual with abnormal color thresholds can read the charts easily, although he may be defective in practical color vision. It is obvious that in the charts the "normal" person can not read, the figures and background are nearly alike in brightness; whereas for the person (color-blind or not) who reads them, there is a brightness difference.

The facts above epitomized have long been known to psychologists, and have even been slowly percolating into elementary psychological texts. They have been ignored by promoters of chart tests and by those who have used them in routine work, because the chart tests can be applied rapidly by persons devoid of training in the psychology of color perception. The valid tests available up to the present time take time and

require an expert to use them. The extensive use of the chart tests in the present war emergency has brought sharply to public attention the fact that these tests are not only unfair, but are also unsafe. It would actually be safer to discard color tests altogether.

That there is some correlation between color thresholds and ability to distinguish colors at normal intensities may be admitted, although the amount of correlation is as yet undetermined. About 80 per cent. of persons who have flunked chart tests have been able, after use of Vitamin A in adequate quantities for an adequate period, to pass these tests. It is suspected that those who become normal for practical purposes, but still fail on some of the charts in a chart test are suffering from dietary insufficiency of protein; but this is not certain.

KNIGHT DUNLAP
ROBERT D. LOKEN
UNIVERSITY OF CALIFORNIA AT LOS ANGELES

THE USE OF GENERIC NAMES AS COMMON NOUNS

A GENERIC name is always a collective noun. It may be masculine or feminine or neuter, but it is always in the nominative case and it is always singular in number. It should be italicized and the first letter should be capitalized. A specific name is always a modifier of the generic name which it follows. It usually is an adjective, but it may be a noun in the genitive case or in apposition with the generic name. It must agree with the generic name in gender and number, and it should be italicized but not capitalized. Examples: *Paramecium caudatum, Amoeba dubia* (specific names, adjectives); *Paramecium calkinsii, Pelomyxa carolinensis* (specific names, nouns in the genitive case); *Amoeba proteus, Felis leo* (specific names, nouns in apposition with the generic names).

A generic name refers to all the individuals which are similar to the type specimens of the genus, and a specific name to all those which are similar to the type specimen of the species. Generic and specific names can therefore not be used to refer to a single organism or to a number of organisms smaller than the total number in the genus or species. To refer to a given number of individuals belonging to a species, *e.g., Amoeba proteus,* it is necessary to designate the number under consideration and add "specimens of," *e.g.,* "a specimen of *Amoeba proteus,*" or "the, some or × specimens of *Amoeba proteus.*" There is no such thing as an *Amoeba proteus,* or an *Amoeba* or the *Amoeba* or some *Amoebae* if the name is italicized and the initial letter is capitalized.

I have found that in some work it becomes very burdensome to use "specimen of" or "specimens of" every time I wish to refer to a given number of individuals belonging to a genus. I have consequently obviated this by using the generic name as a common noun, *e.g.,* an amoeba or some amoebae, without italics or capitals. If generic nouns are used as common nouns there obviously is no more justification for capitals and italics than there is in the use of other common nouns, *e.g.,* cat or cow. This procedure not only avoids excessive use of a cumbersome phrase but it also saves considerable space without any reduction in clarity and precision of meaning, provided the species is known. Wouldn't it be a nuisance if we had to use the phrase "male specimens of *Homo sapiens*" in place of "men" every time we refer to two or more human beings! Imagine an orator beginning his address with "female and male specimens of *Homo sapiens*" in place of "ladies and gentlemen"!

Some assert that it is "vulgar" and "illegitimate" to use generic names as common nouns, but no one, so far as I know, has ever maintained that it is either vulgar or illegitimate to use common names for organisms, *e.g.,* men and cats. I fail to comprehend why the use of a generic name, as a common name, should be considered more vulgar and illegitimate than the use of any other noun. Is it less vulgar, less refined, less common to call, *e.g.,* specimens of *Homo sapiens* "men" than it would be to call them "homines" and specimens of *Felis domestica* "cats" than it would be to call them "feles"? Moreover, a generic name as a common name has some outstanding advantages, for it at once indicates the genus to which the organism belongs, and is readily understood by foreigners as well as by natives. Is it not obviously more illuminating to call, *e.g.,* a specimen of *Chilomonas paramecium* a "chilomonad" than it would be to call it a "carbo" or some other common name?

S. O. MAST
THE JOHNS HOPKINS UNIVERSITY

THEORIES AS TO THE ORIGIN AND NATURE OF LIFE

IN a recent number of SCIENCE,[1] Dr. A. L. Herrera published what is termed "a new theory of the nature and origin of life." An essential preliminary to the enunciation of any theory as to the origin and nature of life must be a statement of the criteria whereby the existence of a living unit may be established.

While there are difficulties in drawing a very sharp line of demarcation between living and non-living,[2] many, perhaps most biologists will accept the criteria of Alexander and Bridges[3]—self-duplication and the ability to direct chemical change by catalysis. The

[1] A. L. Herrera, SCIENCE, 96: 14, July 3, 1942.
[2] J. Alexander, "Colloid Chemistry," 4th ed. (New York, 1937).
[3] J. Alexander and C. B. Bridges, "Colloid Chemistry, Theoretical and Applied," Vol. II, pp. 9–58 (New York, 1928).

simplest conceivable living unit would thus be a molecubiont—a catalyst particle of molecular dimensions, capable of autocatalysis (self-reproduction). The ability to undergo heritable changes is generally observed in living units, and seems to be a third criterion of life, although we can conceive of units incapable of this basis of evolution. Heritable changes in biocatalysts (demonstrated in the case of genes but probable also with enzymes, carriers and prosthetic groups), underlie changes in chemical output due to synthesis and analysis, which in turn are the basis of changes visible in structure, form, physiology and function.

It has long been known that many of the phenomena developed by and in living units may be simulated by non-living systems. Traces of colloidal substances may cause crystallizing material to assume beautiful flower- or fern-like forms. "Colloidal gardens" have long been used as lecture demonstrations, and may be grown by dropping, *e.g.*, a crystal of copper sulfate into sodium silicate solution. "Enzoon," long thought to be a relict of early life, may be nothing but a Liesegang ring formation. Besides the interesting artifacts described by Dr. Herrera in his note above referred to, he has mentioned and illustrated many others in his paper on "Plasmogeny,"[4] and in the same book Professor Stéphane Leduc (Nantes) in a paper on "Solutions and Life" has described and illustrated similar work of his own. Petrologists (*e.g.*, Sir J. S. Flett) have described and simulated dendictic and margaritic forms found in rocks, and window-pane ice often shows beautiful plant- and flower-like tracery.[2]

Although these various artifacts may simulate many of the forms and activities of truly living units, none of them has as yet been shown to exhibit the criteria of life above outlined, which, on the other hand, are all shown by the smallest known bionts (genes, viruses, bacteriophages). Since the same physico-chemical forces and principles dominate both living and non-living units, it seems reasonable to believe that life originated by the chance formation of an autocatalytic unit of molecular dimensions; for the smaller its size, the greater the probability of its formation. Ultramicroscopic bionts which might develop now would have small chance of surviving to form a new race, because of the great number and variety of predatory forms of life now existing. And conditions existing when the first life emerged must have been quite different from present conditions on the earth. Very few living units can even now synthesize their necessary molecules from the "bare rocks," but are largely dependent upon molecules furnished by other bionts. Food thus has an important evolutionary biochemical aspect, and there is truth in the dictum: "Rien n'est la proie de la mort; tout est la proie de la vie."

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QUOTATIONS

THE WOODS HOLE MARINE BIOLOGICAL LABORATORY

THE meetings of the Corporation and Trustees this year were of special significance for they mark the end of Dr. F. R. Lillie's long and fruitful service as an active officer, and the beginning of Mr. Riggs's term as president. Dr. Lillie came to Woods Hole as a beginning investigator in 1891. Nine years later he was made assistant director, and after Dr. Whitman's death in 1908, he became director. During the years that followed, this institution, under his guidance, grew rapidly in prestige and in size. When the extensive building program, which gave us the Brick Building, the Dormitory and the Apartment House, was completed in 1925, he retired as director and was made president of the corporation, a position which he has held until now. Thus, he has seen the laboratory grow from infancy to maturity, and during the intervening years has played a very large part in shaping its policies. It is our good fortune that he will continue to work here and advise those who in the past have relied on his sound judgment and foresight.

To succeed him the trustees named as president Mr. Lawrason Riggs, for the past eighteen years our treasurer. The precedent of having a non-biologist in this position was set many years ago when Mr. C. R. Crane, the generous patron of the laboratory, was chosen. The office of vice-president was created, and was filled by the election of Dr. E. Newton Harvey, professor of physiology at Princeton. Mr. Donald Brodie was made treasurer. He is not a stranger to Woods Hole. For many years he was associated with Mr. Crane, and thus became familiar with the affairs of the laboratory. Dr. Otto Glaser was elected clerk of the corporation in place of Dr. P. B. Armstrong, who resigned. These officers assume their new responsibilities at a critical time. We are confident that under their leadership this institution will continue to serve its primary purpose of encouraging biological research, and will maintain its prestige.

The trustees elected eleven new members of the corporation and named Dr. Glaser and Dr. Metz to serve on the executive committee. The corporation re-elected all the trustees whose terms of office expired

[4] A. L. Herrera, pp. 81–91, and S. Leduc, pp. 59–79, "Colloid Chemistry, Theoretical and Applied," Vol. II.

this year, and elected Dr. Eric Ball and Dr. Eugene F. DuBois to fill the places of Dr. A. P. Mathews and Dr. S. O. Mast, who were made trustees emeriti. Finally, Dr. Lillie was elected president emeritus.

Mr. Riggs, as treasurer, reported that the laboratory is free from indebtedness and has a small reserve fund. The director showed, by means of charts, how the annual income has dropped in the last two years from $170,000 to $130,000. To balance the budget, the executive committee has been forced to make drastic cuts in the appropriations for many of the departments, particularly for research and for the library. While it is true that we can not now buy much apparatus nor receive and pay for foreign journals, we shall presently have to expend considerable amounts for both of these essential items of our equipment.

Dr. Little explained how apparatus now must be repaired and altered to serve new needs, and emphasized the fact that investigators must adapt themselves to these unwelcome conditions. The librarian, Mrs. Montgomery, spoke of the microfilm service which is now in operation. Already it is extensively used. Indeed, we soon may be unable to fulfill all the requests for films.

In the present conditions, it is difficult, if not impossible, to predict the future. But we must assume that next year, research and instruction will continue here at Woods Hole. In the fifty-five years of its existence, this laboratory has maintained these activities without interruption. Every effort will be made to keep them in full operation.—*Dr. Charles Packard, director of the laboratory, in The Collecting Net.*

SCIENTIFIC BOOKS

MATHEMATICS

Mathematics—Its Magic and Mastery. By AARON BAKST. New York: D. Van Nostrand Co., Inc. 1941. $3.95.

To Discover Mathematics. By GAYLORD M. MERRIMAN. New York: John Wiley and Sons, Inc. 1942. $3.00.

Mathematics and the Imagination. By EDWARD KASNER and JAMES NEWMAN. New York: Simon and Schuster. 1940. $2.75.

To tear from mathematics the veil of misconception which obscures it in the popular mind and to reveal it in aspects as antithetical as may be to the cramped or forbidding ones of the elementary schoolroom is a quest which is currently calling forth a swelling volume of literary effort. The reading public is no longer a stranger to prospectuses and prefaces which beckon with promises of easy and painless instruction in the ways and uses of numbers, or which give voluble assurances of a ready entrance into the temple where the beauties and sublimities of mathematics lie revealed, and where all may grasp the grandeur and boldness of its harmonies and symmetries or of its all-pervading utilities. Mathematics, one is assured, is ineradicably ingrained in human thought and achievement. *Ipso facto* some modicum both of understanding of its subject-matter and appreciation of its essence is no less than a *sine qua non* of the educated and cultured man. To supply these desiderata the proffered volumes exist.

As must be, different readers will differently appraise the success which crowns each specific effort. The mark aimed at is high—perhaps too high. Poor and friendless thing though the more standard mathematical textbook may be, it is certainly no parvenu. Its claims of ancestry go back to Euclid often with much more justice than to the name which graces its title page, and over its evolution both savants and pedagogues have labored much. However popular it may be to eschew it, its earmarks will assert themselves, whenever the mere discourse about mathematics yields to any actual presentation of theory or fact. By the same token, the extant body of truly significant mathematical ideas was not easily come by. It was, on the contrary, a halting accretion, the crystallization of inordinately sustained and groping effort. There is small evidence that we are brighter than were our ancestors. It seems a far cry, therefore, from the great Gaus' misgivings as to the wit of the "Boethians," to the ostensibly easy confidence with which many present-day writers essay upon the exposition of abstract and basic ideas to any tyro, if he will but think.

Of the volumes here specifically under review, that which makes least demand upon previous knowledge is "Mathematics—Its Magic and Mastery." Written in an engaging style, and amply supplied with figures and entertaining vignettes, approximately one half of the book's 790 pages are designed largely for amusement. This is the magic of it. Easy discussions of the elementary arithmetic processes are flavored with parlor tricks, with examples of the coincidences which attach to combinations of numbers appropriately adjusted to their base of notation, with interesting visualizations of large numbers or very small ones, with puzzles, codes, etc. This will entertain all who enjoy the manipulation of numbers or who delight in the manifold disclosures of curious and unexpected regularities. In the later pages the domi-

nance of theme passes to the mastery. One meets there, in conjunction with appropriate applications, with progressions, logarithms, exponentials and probabilities, with geometry—plane, solid and analytic, with trigonometry, ballistics, etc. The inexperienced reader will find the going here slower. Upon occasion he will understand better the author's statement: "There was a time when mathematics was regarded as an intricate subject," than he will the assertion: "Fortunately, this day is long past." More experienced readers may learn less, but will enjoy more. There is much here wherewith the more sober presentations of ordinary textbooks can be supplemented and enlivened.

"To Discover Mathematics" is, for all its intentionally informal style, a didactic rather than an entertaining volume. Though chapters may be headed in such manner as: "The Fountain Head," "Magic of the Mind," "Declaration of Independence," etc., these superscriptions, in fact, refer to discussions of elementary algebraic and number theoretic matters, of geometric methods, synthetic or analytic, of logarithms and exponentials, or of trigonometry and the calculus. Professedly the book is designed to expose the utility and beauty of mathematics through the use of elementary but significant material, and to this profession it adheres with considerable success. This reviewer would recommend this book to many an advanced college student. Such will find it easy—perhaps in spots a trifle tedious—but may draw from it on the whole a rewarding synthesis of many disparate topics.

The proclaimed mission of "Mathematics and the Imagination" is "to extend the process of haute vulgarization to those outposts of mathematics which are mentioned, if at all, only in a whisper; which are referred to, if at all, only by name; to show by its very diversity something of the character of mathematics, of its bold, untrammeled spirit, of how—as both an art and a science—it has continued to lead the creative faculties beyond even imagination and intuition." The reader will find here clever discussions of the possibilities of largeness in numbers and of smallness, of the finite versus the transfinite, of the limiting process, of analytic geometry (to n dimensions), of Euclidian and non-Euclidian geometries, of mathematical pastimes and paradoxes, of probability, topology and the calculus (to space filling curves, and curves without tangents). It goes without saying that with a program so broad the discussion is far from exhaustive, nor was it the intention that it should be so. Lest the reader regard the subjects as too profound, the author gives incidental assurances to the effect that the "high and mighty mumbo jumbo" in terms of which they are usually couched, is wholly dispensable, since "High priests in every profession devise elaborate rituals and obscure language as much to conceal their own ineptness as to awe the uninitiate." Even in the face of such an exhortation, one might still hold that the mathematically sophisticate will glean more from this book than will the novice. For those already in possession of some outlook in mathematics and who wish either to broaden it, or at least to militate against its ossification, this book is wholly recommendable.

The authorship of books such as these is a laudable and withal no simple task. Of the beauties and essentials of mathematics a few, to be sure, are easily accessible. For a proper appreciation, however, even these frequently demand a deeper understanding. By and large, what lies near the surface of the subject belongs much more often among its trivia than among its profundities. The navigable literary channel between the Scylla of unintelligibility and the Charybdis of tediousness, is thus prevailingly narrow. Is it surprising, therefore, that the discovery of a royal road to mathematics is not yet to be signalized? That is, perhaps, after all, a hopelessly Utopian vision.

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SPECIAL ARTICLES

THE INORGANIC CONSTITUTION OF BONE

THROUGHOUT the last century there has been active discussion regarding the inorganic constitution of bone. Analyses show that the principal constituents are calcium, phosphate and carbonate with minor amounts of magnesium and sodium. Bone gives an x-ray diffraction pattern similar to that of the mineral apatite, the unit of structure of which contains $Ca_{10}(PO_4)_6F_2$. Various substitutions, such as $(OH)^-$ for F^- and Mg^{+2} for Ca^{+2}, are known to occur in the apatite lattice without producing significant changes in the diffraction pattern.

Suggested formulas for the phosphate compound of bone and their latest proponents are: $Ca_5H_2(PO_4)_4$, Berzelius (1845); $Ca_{10}(PO_4)_6CO_3$, Gassman (1937); $Ca_{10}(PO_4)_6(OH)_2$, Klement (1938); a neutral compound containing carbonate, Logan (1938); $(Ca,C)_{8\text{-}9}[(P,C)O_4]_6Ca(OH)_2$, Gruner, McConnell and Armstrong (1937).[1] In the last formula carbon is present not only in hypothetical $[CO_4]^{-4}$ groups but also as C^{+4} ions replacing Ca^{+2} ions.

[1] References are to be found in recent review articles; C. Huggins, *Physiol. Rev.*, 17: 119, 1937, and S. Eisenberger, L. Alexander and W. D. Turner, *Chem. Rev.*, 26: 257, 1940.

Possibility of carbonate substitution in the apatite lattice was summarily demonstrated by McConnell and his coworkers.[1] We now find that this substitution, unlike the one suggested by these authors, involves replacement of $3(PO_4)^{-3}$ groups by $4(CO_3)^{-2}$ groups with accompanying changes, such as Ca^{+2} replacement by Na^+, in the positive ions to maintain balance of charge. The manner in which this possibly takes place is shown in Fig. 1 (A) and (B).

Tricalcium phosphate prepared from solutions also has an apatite type structure giving a diffraction pattern closely similar to that of bone and thus must be considered. This compound, the existence of which is questioned in almost all the literature on the subject, can readily be prepared in crystalline form as shown by the electron microscope; a convenient method of preparation being hydrolysis of $CaHPO_4 \cdot 2H_2O$ in solutions more acid than pH 5.0 at 100° C. Its limiting formula appears to be $Ca_3(PO_4)_2 \cdot 2/3H_2O$ and the water is unusual in that much of it is held to 600° C. In this respect the compound resembles the silicate mineral apophyllite[2] in the lattice of which water probably is split into H^+ and $(OH)^-$ ions as required by Pauling's electrostatic valence principle. The apatite-like unit of structure of tricalcium phosphate hydrate contains $[Ca_9](PO_4)_6(H_2O)_2$ which perhaps is better written as $[Ca_9(H^+)_2](PO_4)_6(OH)^-_2$. A probable way in which these substitutions take place in the apatite lattice is shown in Fig. 1 (C) and (D). The phosphate of this compound can be partially replaced by carbonate as in other apatites.

The neutral or basic character of the inorganic compound is ascertainable by accurate analysis of properly prepared samples of bone. Unfortunately, most analyses have been carried out on bone from which organic matter was removed by methods which would result in hydrolysis of a neutral compound. Many other analyses of bone show an apparent excess of positive ions due to incomplete recovery of phosphate.[3,4]

Trustworthy analyses,[5, 6, 7] with the magnesium and sodium determinations of Klement,[8] indicate that the average composition of the unit of structure for the apatite compound of human bone is near

$$[Ca_{8.50}Mg_{0.25}Na_{0.10}][(PO_4)_{5.07}(CO_3)_{1.24}](H_2O)_{2.0}$$

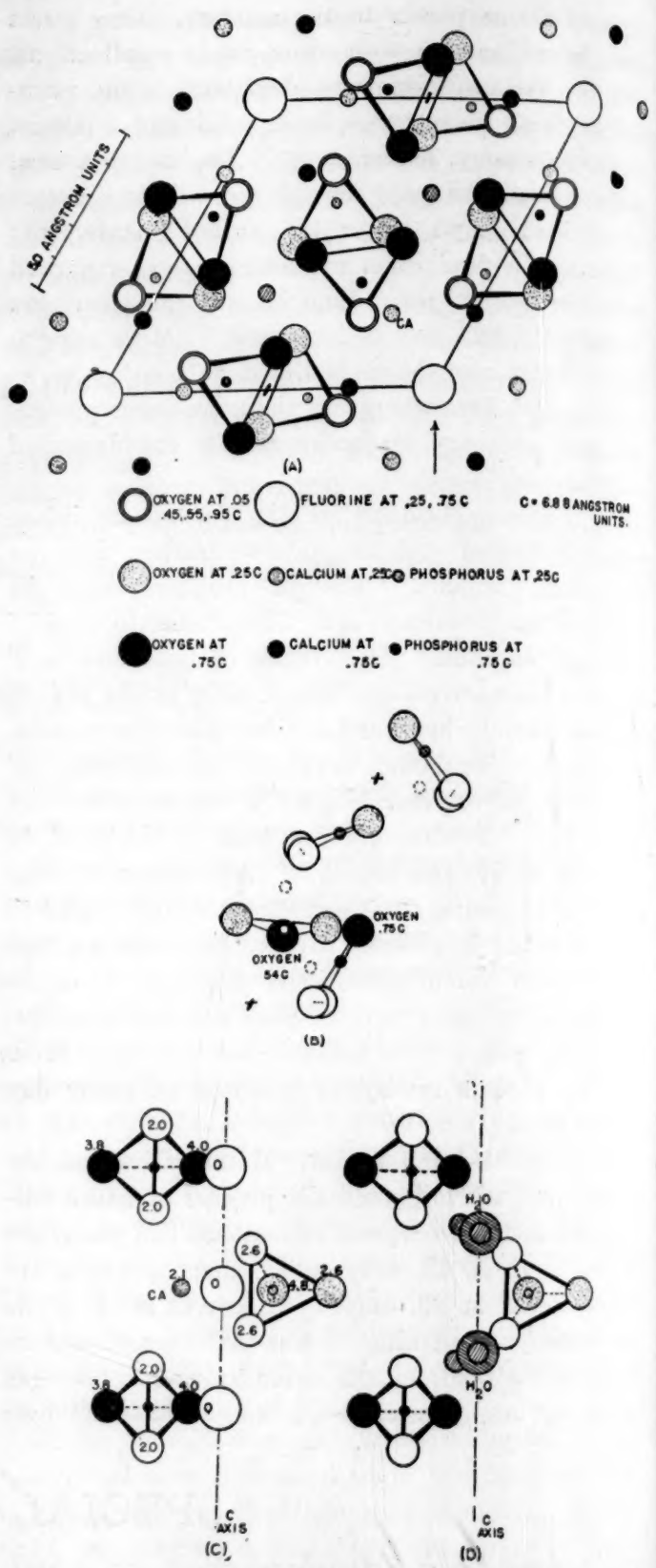

FIG. 1: (A) Projection of the apatite structure on the basal plane. Since each PO_4 group has one edge parallel to the c axis two oxygen atoms of a group are superimposed and the group thus appears as a triangle. (B) Projection parallel to the c axis showing a way in which $4CO_3^{--}$ groups can replace $3PO_4^{---}$ groups. Relationship of this projection to (A) can be seen by superimposing the plus marks. (C), (D) Projection of a portion of the apatite structure on (10.0) [along the arrow in (A)] showing the manner in which Ca^{+2} and $2F^-$ are replaced by $2H_2O$ or $2(OH)^-$ and $2H^+$ ions. Distances in angstrom units from the projection plane are indicated.

Sodium, of course, may replace Ca^{+2} ions on account of similarity in ionic radius and to an extent that de-

[2] W. L. Bragg, "Atomic Structure of Minerals," Ithaca, pp. 226 *ff.*, 1937.

[3] C. M. Burns and N. Henderson, *Biochem. Jour.*, 29: 2385, 1935.

[4] A. E. Hoffman and P. Caldwell, *Jour. Assoc. Official Agr. Chem.*, 25: 206, 1942.

[5] M. A. Logan, *Jour. Biol. Chem.*, 110: 375, 1935.

[6] C. M. Burns and N. Henderson, *Biochem. Jour.*, 30: 1207, 1937.

[7] J. Marek, O. Wellmann and L. Urbanyi, *Zeit. f. Physiol. Chem.*, 226: 3, 1934.

[8] R. Klement, *Naturwiss.*, 26: 145, 1938.

pends upon the Na^+ concentration in plasma. Limited analytical results from the literature indicate that dentine, while still a hydrated tricalcium phosphate, differs significantly from bone in having a possibly higher Mg^{+2} and lower $(CO_3)^{-2}$ content. Its average formula approaches

$$[Ca_{8.36}Mg_{0.45}Na_{0.16}][(PO_4)_{5.34}(CO_3)_{0.88}](H_2O)_{2.0}$$

Enamel on the other hand is a more basic compound and a representative sample of human enamel has the formula

$$[Ca_{9.48}Mg_{0.18}Na_{0.11}][(PO_4)_{5.67}(CO_3)_{0.45}](OH)_{1.54}(H_2O)_{0.46}$$

which approaches that of a carbonate hydroxyapatite.

Possible variation in the basicity and composition of the inorganic compound of bone with type, species, age and pathological condition, although the subject of many studies in the past, can only be ascertained by further extensive analyses in which the errors of past work are avoided and in which the minor but not unimportant sodium and magnesium are determined. In general, evidence now available would seem to indicate that bone contains a hydrated tricalcium phosphate type of compound instead of hydroxyapatite as widely accepted and that sodium and carbonate are essential constituents of this compound.

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OCCURRENCE OF AVIDIN IN THE OVIDUCT AND SECRETIONS OF THE GENITAL TRACT OF SEVERAL SPECIES

AVIDIN, the anti-biotin factor which produces egg-white injury, has hitherto been known to exist only in the white of the hen's egg.[1] The site of origin and physiological significance of this potent biological substance have remained obscure. The white of the hen's egg represents a secretion from the mucosal lining of the oviduct.[2] Since the translucent jelly-like secretion found adherent to frogs' eggs is the direct homologue of the white of the bird's egg, it was deemed advisable to determine whether avidin might be present in this secretory product of the frog oviduct as well as in the oviduct itself. In addition, the oviduct of the hen and the eggs of several other species of birds were also assayed for avidin.

The materials to be tested were obtained in the fresh state, spread on glass plates and dried in a current of warm air at 37° C. The dried preparations were then pulverized and assayed for avidin by the yeast-growth method of Eakin *et al.*[3]

It was found that avidin exists in readily demonstrable quantities in the oviduct of both the hen and wood frog (Table I). It is noteworthy that the egg-jelly from two different species of frogs also contains very considerable anti-biotin potency. The presence of avidin in the egg-white of all the species of fowl tested should also be noted.

TABLE I

AVIDIN CONTENT OF BIRD AND AMPHIBIAN TISSUES AND SECRETIONS

Species	Material assayed	Units* of avidin per gm. dried weight
Hen (New Hampshire)	Egg white	11.5
	Oviduct	2.3
	Intestine	0.0
Wood frog (R. sylvatica)	Egg jelly	1.7
	Oviduct	0.75
	Intestine	0.0
Pickerel frog (R. palustris)	Egg jelly	1.5
Turkey	Egg white	16.2
Duck	" "	7.1
Goose	" "	8.0

* A unit of avidin is that amount required to completely neutralize the yeast growth supported by one microgram of free crystalline biotin.

Dried intestine of the hen and of the frog was employed as a control tissue and was found to contain no demonstrable activity.

The relatively low titres found in the oviduct of the hen and of the frog may be accounted for by the fact that the muscularis and stroma of these organs contribute a considerable proportion of inert material to the assay.

These data suggest that avidin is a secretory product of the oviduct of birds and amphibia and therefore may play an important role in embryonic development and in the physiology of the genital tract.

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HEREDITARY TRANSMISSION OF INDUCED TETRAPLOIDY AND COMPATIBILITY IN FERTILIZATION

THE writers have reported[1] that the change to a tetraploid condition ($4n = 28$ chromosomes) induced by colchicine in the branches of self-incompatible diploid ($2n = 14$ chromosomes) plants of *Petunia axillaris* (Lam.) B. S. P. was accompanied by a change to self-compatibility in fertilization and seed formation. It may now be reported that further investigations show that the condition of self-com-

[1] P. Gyorgy, *Annual Review of Biochemistry*, xi: 337, 1942.

[2] B. Patten, "Embryology of the Chick." P. Blakiston's Son and Co., Inc., Philadelphia. 1929.

[3] R. E. Eakin, E. E. Snell and R. J. Williams, *Jour. Biol. Chem.*, 140: 535, 1941.

[1] A. B. Stout and Clyde Chandler, SCIENCE, 94: 118, 1941.

patibility was transmitted to all seedlings thus far obtained from the selfed flowers of tetraploid branches and also that there was compatibility for all cross-relations among each series of these seedlings.

A total of 212 plants were grown from seeds obtained by controlled self-pollinations of eight flowers on tetraploid branches. The seedlings obtained from each capsule were pedigreed and numbered in a series. Three series were from different capsules of the same plant. Each of the other five series was from a different plant.

All seedlings of selfed tetraploid branches were tetraploid. All had the several characters which differentiated the tetraploid branches from diploid plants and branches. The corollas of the flowers, the anthers and the stigmas were definitely larger. There was appreciable increase in size for a maximum of about 50 per cent. of the pollen grains of a plant and these had four germ pores instead of three, which is the typical condition for diploid plants of this species. For the tetraploid plants whose pollen was examined the abortion of pollen ranged from 15 per cent. to 50 per cent. The chromosome numbers for 45 of the seedlings were determined; all were tetraploid. Thus all seedlings obtained from tetraploid flowers were tetraploid, which indicates that in the self-fertilizations of the tetraploid flowers only pollen and egg cells that were diploid had functioned in seed production.

All the tetraploid seedlings were self-compatible. Each of these plants was tested by controlled self-pollinations. Every one was highly self-compatible to its own pollen. Only one seedling produced small capsules to self-pollination, the largest of which had 65 seeds. Except for this plant there was no evidence of a partial selective incompatibility that results in reduced seeding.

The tetraploid seedlings of a series were cross-compatible in all intra-cross-relations. For one series of 44 siblings all possible cross-pollinations between 20 plants were made and six of these plants were used both as pollen and as seed testers with the other 24 members of the series. Similar tests were made for each of the other seven series of plants to a total of approximately 2,000 cross-combinations. In each and every one of these cross-relations large capsules well filled with seed were obtained.

Of back-cross-relations only those of tetraploid seedlings x diploid parent were cross-incompatible. Both diploid and tetraploid branches of each of several of the original plants which were treated with colchicine were propagated as clones and used in various cross-pollinations with their own tetraploid seedlings.

(1) A parent tetraploid clone as a seed parent with any of its tetraploid seedlings as a pollen parent was cross-compatible for every one of the 54 combinations that were tested.

(2) A parent diploid clone as a seed parent with any of its tetraploid seedlings as a pollen parent was cross-compatible for every one of the 130 combinations tested.

(3) Of the 142 cross-combinations tested for tetraploid seedlings x a parent tetraploid clone, every one was highly compatible.

(4) Tetraploid seedlings were tested as seed parents in 213 different combinations with the parent diploid as a pollen parent and in every case there was complete incompatibility.

Studies in pollen-tube behavior were made which revealed that:

(1) in all combinations which involve the pollen of tetraploid flowers the more advanced pollen tubes grew rapidly and reached the ovary within 48 hours after pollination.

(2) in self-pollination of self-incompatible diploid plants the pollen germinated but the more advanced tubes grew so slowly that at the end of six days none were observed more than three-fifths of the distance from stigma to ovary.

(3) in the cross-pollinations with tetraploids the pollen grains of a parent diploid germinated and grew at approximately the same rate as when used in self-pollination.

The results reported above were fully definite and conclusive for the material studied. The condition of induced tetraploidy eliminated the self-incompatibility that operated in the diploid somatic parent. This condition was transmitted to all the tetraploid recombinations of genetic factors which were obtained in each of the seed progenies. Also among the members of each progeny there was complete cross-compatibility for at least some one of the classes of pollen that segregated from the tetraploid complex. In back-cross relations the only incompatibility that continued was when the haploid pollen of a self-incompatible parent was used to pollinate a pistil of the tetraploid offspring. In the diploid plants of *Petunia axillaris* there is genetic control[2] in the relations of fertilization which effects self- and cross-incompatibilities. But when these genetic factors were duplicated in tetraploid branches and in their seed progenies there was no longer expression in respect to seed production of either self-incompatibility or intra-sib cross-incompatibility.

A. B. STOUT
CLYDE CHANDLER
THE NEW YORK BOTANICAL GARDEN

[2] A. B. Stout, *The Botanical Review*, 4: 275–369, 1938.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE STUDENTS' ASTROLABE

THE device which I am about to describe has been employed for several years in teaching a part of the general science course to students in Columbia College. It is used in the astronomical part of the course to introduce the conception of the celestial sphere and is designed for outdoor observations. Aside from the fact that it well serves the purpose for which it was made it has several other attributes to commend it, namely: it is sufficiently inexpensive so that each student can have his own instrument; it is made of readily available materials so that almost any student can make one for himself; it provides a tool for astronomical observation available to inexperienced students who could not personally handle the expensive and intricate instruments of the observatory; it requires accuracy of technique just within the range of the undergraduate level (that is, for the non-scientific students notoriously lacking in manual dexterity); and finally it offers a means for introducing scientific observation and reasoning into matters of daily occurrence. This last function is in fact the main purpose of the whole course.

The instrument in question is called the students' astrolabe. Its principle is that of the telescope with equatorial mounting, but instead of a telescope there is only a pointer. In action the astrolabe makes use of a knowledge of right ascension, declination, sidereal time, altitude of the North Star, latitude, ecliptic and Vernal Equinox. The accompanying illustration hardly needs an explanation except to point out the fact that by means of the tripod the instrument can readily be set up so that the long rod, or right ascension axis, can be pointed at the North Star. This is done by sighting through the eyelets on the pointer, which is first set in the position shown. The declination disk is securely fastened to a flattened side of the long rod, the lower end of which passes through the right ascension disk and rests on a hole bored in the tripod head. The small indicator close to the right ascension disk is set in a plane parallel to the declination disk.

The simplest way to use the instrument is to take it out at night and point it directly at the North Star, a feat readily accomplished by adjusting the tripod legs. If the North Star is not visible because of clouds, buildings or too much light, the instrument

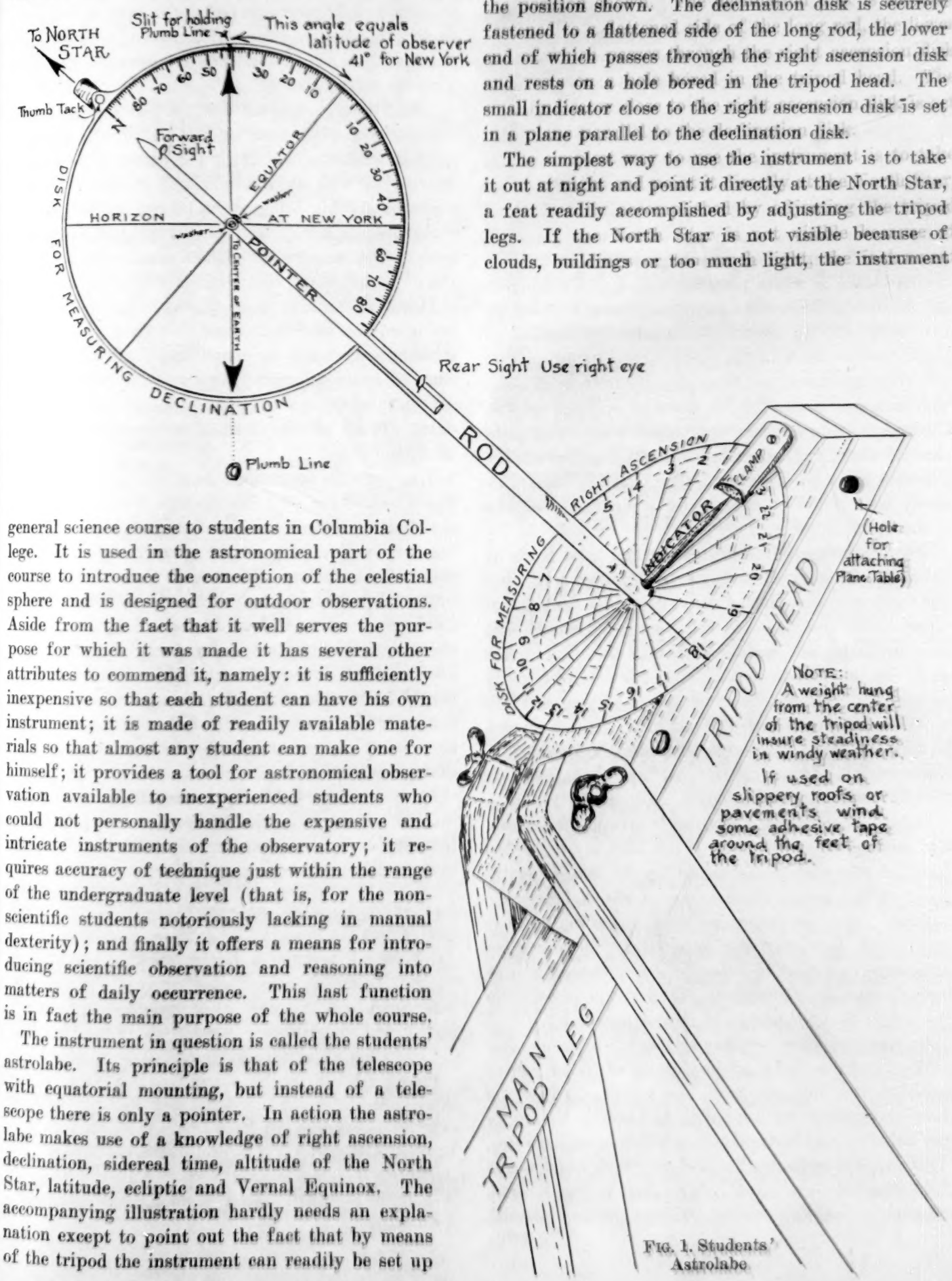
To NORTH STAR
Slit for holding Plumb Line
This angle equals latitude of observer 41° for New York
Thumb Tack
Forward Sight
EQUATOR
HORIZON
AT NEW YORK
DISK FOR MEASURING DECLINATION
POINTER
To Center of Earth
Plumb Line
Rear Sight Use right eye
ROD
RIGHT ASCENSION
INDICATOR
CLAMP
(Hole for attaching Plane Table)
TRIPOD HEAD
NOTE: A weight hung from the center of the tripod will insure steadiness in windy weather.
If used on slippery roofs or pavements wind some adhesive tape around the feet of the tripod.
MAIN TRIPOD LEG

FIG. 1. Students' Astrolabe

patibility was transmitted to all seedlings thus far obtained from the selfed flowers of tetraploid branches and also that there was compatibility for all cross-relations among each series of these seedlings.

A total of 212 plants were grown from seeds obtained by controlled self-pollinations of eight flowers on tetraploid branches. The seedlings obtained from each capsule were pedigreed and numbered in a series. Three series were from different capsules of the same plant. Each of the other five series was from a different plant.

All seedlings of selfed tetraploid branches were tetraploid. All had the several characters which differentiated the tetraploid branches from diploid plants and branches. The corollas of the flowers, the anthers and the stigmas were definitely larger. There was appreciable increase in size for a maximum of about 50 per cent. of the pollen grains of a plant and these had four germ pores instead of three, which is the typical condition for diploid plants of this species. For the tetraploid plants whose pollen was examined the abortion of pollen ranged from 15 per cent. to 50 per cent. The chromosome numbers for 45 of the seedlings were determined; all were tetraploid. Thus all seedlings obtained from tetraploid flowers were tetraploid, which indicates that in the self-fertilizations of the tetraploid flowers only pollen and egg cells that were diploid had functioned in seed production.

All the tetraploid seedlings were self-compatible. Each of these plants was tested by controlled self-pollinations. Every one was highly self-compatible to its own pollen. Only one seedling produced small capsules to self-pollination, the largest of which had 65 seeds. Except for this plant there was no evidence of a partial selective incompatibility that results in reduced seeding.

The tetraploid seedlings of a series were cross-compatible in all intra-cross-relations. For one series of 44 siblings all possible cross-pollinations between 20 plants were made and six of these plants were used both as pollen and as seed testers with the other 24 members of the series. Similar tests were made for each of the other seven series of plants to a total of approximately 2,000 cross-combinations. In each and every one of these cross-relations large capsules well filled with seed were obtained.

Of back-cross-relations only those of tetraploid seedlings x diploid parent were cross-incompatible. Both diploid and tetraploid branches of each of several of the original plants which were treated with colchicine were propagated as clones and used in various cross-pollinations with their own tetraploid seedlings.

(1) A parent tetraploid clone as a seed parent with any of its tetraploid seedlings as a pollen parent was cross-compatible for every one of the 54 combinations that were tested.

(2) A parent diploid clone as a seed parent with any of its tetraploid seedlings as a pollen parent was cross-compatible for every one of the 130 combinations tested.

(3) Of the 142 cross-combinations tested for tetraploid seedlings x a parent tetraploid clone, every one was highly compatible.

(4) Tetraploid seedlings were tested as seed parents in 213 different combinations with the parent diploid as a pollen parent and in every case there was complete incompatibility.

Studies in pollen-tube behavior were made which revealed that:

(1) in all combinations which involve the pollen of tetraploid flowers the more advanced pollen tubes grew rapidly and reached the ovary within 48 hours after pollination.

(2) in self-pollination of self-incompatible diploid plants the pollen germinated but the more advanced tubes grew so slowly that at the end of six days none were observed more than three-fifths of the distance from stigma to ovary.

(3) in the cross-pollinations with tetraploids the pollen grains of a parent diploid germinated and grew at approximately the same rate as when used in self-pollination.

The results reported above were fully definite and conclusive for the material studied. The condition of induced tetraploidy eliminated the self-incompatibility that operated in the diploid somatic parent. This condition was transmitted to all the tetraploid recombinations of genetic factors which were obtained in each of the seed progenies. Also among the members of each progeny there was complete cross-compatibility for at least some one of the classes of pollen that segregated from the tetraploid complex. In back-cross relations the only incompatibility that continued was when the haploid pollen of a self-incompatible parent was used to pollinate a pistil of the tetraploid offspring. In the diploid plants of *Petunia axillaris* there is genetic control[2] in the relations of fertilization which effects self- and cross-incompatibilities. But when these genetic factors were duplicated in tetraploid branches and in their seed progenies there was no longer expression in respect to seed production of either self-incompatibility or intra-sib cross-incompatibility.

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[2] A. B. Stout, *The Botanical Review*, 4: 275–369, 1938.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

THE STUDENTS' ASTROLABE

THE device which I am about to describe has been employed for several years in teaching a part of the general science course to students in Columbia College. It is used in the astronomical part of the course to introduce the conception of the celestial sphere and is designed for outdoor observations. Aside from the fact that it well serves the purpose for which it was made it has several other attributes to commend it, namely: it is sufficiently inexpensive so that each student can have his own instrument; it is made of readily available materials so that almost any student can make one for himself; it provides a tool for astronomical observation available to inexperienced students who could not personally handle the expensive and intricate instruments of the observatory; it requires accuracy of technique just within the range of the undergraduate level (that is, for the non-scientific students notoriously lacking in manual dexterity); and finally it offers a means for introducing scientific observation and reasoning into matters of daily occurrence. This last function is in fact the main purpose of the whole course.

The instrument in question is called the students' astrolabe. Its principle is that of the telescope with equatorial mounting, but instead of a telescope there is only a pointer. In action the astrolabe makes use of a knowledge of right ascension, declination, sidereal time, altitude of the North Star, latitude, ecliptic and Vernal Equinox. The accompanying illustration hardly needs an explanation except to point out the fact that by means of the tripod the instrument can readily be set up so that the long rod, or right ascension axis, can be pointed at the North Star. This is done by sighting through the eyelets on the pointer, which is first set in the position shown. The declination disk is securely fastened to a flattened side of the long rod, the lower end of which passes through the right ascension disk and rests on a hole bored in the tripod head. The small indicator close to the right ascension disk is set in a plane parallel to the declination disk.

The simplest way to use the instrument is to take it out at night and point it directly at the North Star, a feat readily accomplished by adjusting the tripod legs. If the North Star is not visible because of clouds, buildings or too much light, the instrument

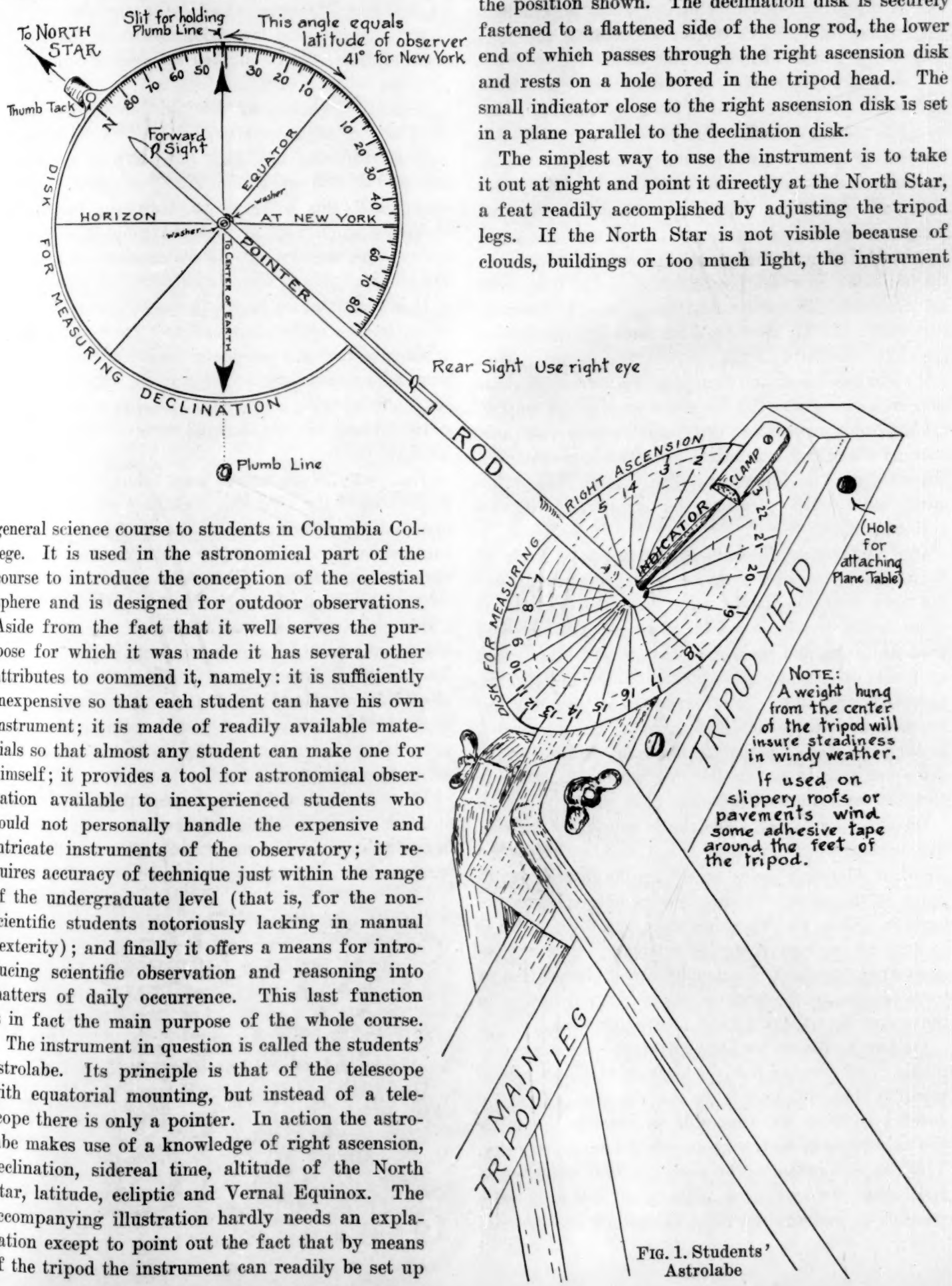

FIG. 1. Students' Astrolabe

may be accurately placed by orienting it with a magnetic compass with due allowance for compass declination, and by using a plumb bob to get the right slant, as suggested in the picture for a station in the latitude of New York. The plumb bob consists of a small weight supported by a thin thread which is held in a slit on the degree mark on the declination disk corresponding to the latitude of the place.

The next adjustment is to turn the right ascension disk to its proper position. This is the same as rectifying a celestial globe. The easiest way to do this accurately is to turn the pointer and also the rod on its axis so as to sight upon some known star whose right ascension may be learned from the Nautical Almanac or from a star map. Then turn the right ascension disk until the proper hour mark is opposite the indicator, in which position it should be temporarily clamped. The instrument may now be used in two ways: (1) To identify unknown stars sight upon the unknown star with the pointer, read its declination and right ascension, and then identify it from its position on a star map; (2) To make an original map of the sky, plot on a blank sky map the observed positions of stars and constellations whose actual names, however, may be unknown. The original map may later, with much pleasure, be compared with an authentic map.

One of the most interesting uses we have made of the astrolabe is to set it up in the daytime, rectifying the right ascension disk by using the tables for sidereal time on the first pages of the Nautical Almanac and then adjusting the pointer so that it will be directed at a certain star to appear some time that evening several hours later. The instrument is then left untouched until that time has arrived. As we have a battery of these astrolabes available, different students are able to set up the instruments in order to view different stars at different later times.

Daytime use of the astrolabe is especially instructive because the North Star is not visible. From the Nautical Almanac tables we set up the instrument to point at the moon, which often as not is below the horizon. Then we determine what phase the moon is in and the hour of rising or setting. These conclusions are later checked either by direct observation or by reference to the almanac, thus giving practice in the use of that valuable and interesting book.

On two occasions we have set up the instrument at midday and directed it at the location of Venus, whose position was obtained from the almanac. Then by careful scrutiny we were able to observe Venus by the naked eye at high noon in a brilliant summer sky. This perhaps indicates the accuracy with which celestial bodies can be located. We found that it is quite possible to measure the right ascensions and declinations of the three stars in the belt of Orion which are perhaps only a degree or two apart.

Other kinds of observations readily suggest themselves, such as locating the position of a planet in the sky (be it either above or below the horizon) by using the right ascension and declination figures given in the almanac, and from this determine the planet's configuration which can then be checked against the almanac tables.

Night-time studies of the invisible sun as well as daytime and night-time studies of the invisible moon suggest problems by which the times of sunset and sunrise as well as moonset and moonrise may be determined, this being accomplished by turning the right ascension rod so that the pointer is directed toward the western or eastern horizon and making the other necessary observations and adjustments.

It is possible also to set up the instrument for any point on the earth's surface and from the almanac tables giving right ascension and declination of the sun and moon determine the time of sunrise and sunset, and moonrise and moonset at any latitude on any date. These results can be compared with other almanac tables.

We venture to believe that simple, home-made apparatus of the type described may be used to wean the students away from the idea that scientific thinking can be done only in the midst of test-tubes and elaborate equipment. Courses in general science are presumably designed to inculcate a habit of scientific thinking in matters of all kinds and for that reason the use of readily made instruments is to be encouraged as such devices are available at all times. It should be remembered that the vast majority of students taking courses in general science, after they leave school, never have access to factory-made laboratory apparatus.

If we learn that this short account proves to be of interest to other science teachers we may have the temerity to describe one or two other simple things that we have done along these lines.

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BOOKS RECEIVED

ABRAMSON, HAROLD A., LAURENCE S. MOYER and MANUEL H. GORIN. *Electrophoresis of Proteins and the Chemistry of Cell Surfaces.* Illustrated. Pp. 341. Reinhold Publishing Corporation. $6.00.

BIRKELAND, JORGEN. *Microbiology and Man.* Illustrated. Pp. x + 478. F. S. Crofts and Co., New York. $4.00.

HRDLIČKA, ALEŠ. *Catalog of Human Crania in the United States National Museum Collections: Eskimo in General.* Pp. 169 + 429. Smithsonian Institution.

MILLS, CLARENCE A. *Climate Makes the Man.* Illustrated. Pp. vi + 320. Harper and Brothers. $3.00.

RIEGEL, EMIL RAYMOND. *Industrial Chemistry.* Illustrated. Pp. 861. Reinhold Publishing Corporation. $5.50.